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An Empirical Test of the Market Model Based On Expected Dividends, Earnings, and Firm Size For TSE Common Stocks

by

© David C. Mulder

A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled, "An Empirical Test of the Market Model Based On Expected Dividends, Earnings, and Firm Size for TSE Common Stocks" submitted by David C. Mulder in partial fulfilment of the requirements for the degree of Master of Business Administration

ABSTRACT

The purpose of this thesis is to test the Market Model using Canadian data, and determine which if any of three firm-specific variables are fully captured by the linear model. Using a methodology similar to that used by researchers on U.S. data and using financial data from an average of 150 TSE common stocks, the empirical results showed that the null hypothesis that the Market Model is complete can be rejected at the 10% level of significance on the basis of aggregating the data during three test years 1969, 1973 and 1977. The Market Model fails because the returns on the portfolios of TSE securities are also a function of such firm-specific variables as the E/P ratio and, to a lesser extent, the D/P ratio. Only a negligible firm size effect was detected. Several pieces of empirical and theoretical evidence support the conclusions that the independent E/P and D/P effects are robust with respect to variants of the basic methodology adopted, and that the Market Model is misspecified rather than capital markets being informationally inefficient. In arriving at this last conclusion, however, it must be realized that the Market Model was tested over three turbulent one-year periods, such that violating the assumptions of the Market Model is bound to have an adverse effect on the performance of the model itself.

ACKNOWLEDGMENT

I wish to acknowledge professors S. Tiniç and S. Beveridge of the Faculty of Business, University of Alberta, for having provided invaluable guidance in selecting a topic and methodology, respectively, and in preventing me from straying off onto sterile tangents; also to Messrs N. Weimer and B. Hsu for their computing assistance, without whose help I could never have generated my abnormal returns. Numerous others have made direct and indirect contributions, including representatives of companies who responded to my requests for information and helped me assemble a difficult data base; my wife, Bonnie, for her selfless efforts in typing an esoteric handwritten manuscript; and last but not least to Mrs. Jacki Jorgensen for typing up the final version in acceptable thesis format.

As a young boy I recall my father taking me on sunny days into smoke-filled brokerage offices where old men sat mesmerized by an overhead ticker-tape. Over the years he has sent me a wealth of financial advice in innumerable letters and investment newsletters. Perhaps this continuous exposure to the world of investment finance had something to do with my having selected a thesis topic in this area of business.

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CHAPTER I

INTRODUCTION

During the summer and fall of 1980, the writer met with representatives of the investment industry in various cities in western Canada. He had discussions with about a dozen individuals who were regarded as the more intellectual members of the investment community for the purpose of obtaining a practical and timely topic for an MBA thesis. After reviewing some suggested topics, the writer perceived that the individuals he contacted had not really pondered the basic principles which explain <u>why</u> things happen the way they do or even <u>how</u> they happen. These practitioners appeared to be up-to-date on <u>what</u> was happening at that point in time in various segments of the market, <u>who</u> was buying and selling, and even suggested theories based on "technical analysis" concerning <u>when</u> to buy and sell. The various aspects of the market of interest to them revolved around such topics as testing technical analysis trading rules and comparing Canadian and South African gold stocks. Although the writer has had little practical experience in investment finance, he wished to tackle a relatively broad topic in which he could gain some understanding of why and how the market behaves the way it

does, and how to conduct basic research to gain this deeper understanding. He desired a topic within the realm of "fundamental analysis" which would become a learning experience in the investment side of capital market thoery, as well as a practical contribution in published form.

Several professors in the Department of Finance and Management Science at the University of Alberta informed the writer that beginning in the mid 1960's and followed by an improved quality of research in the early 1970's, scholars working mainly on U.S. data began to suggest that inconsistencies may exist in the several versions of the Capital Asset Pricing Model which cruder data and techniques missed in the past. In mid 1978 there was a "Symposium on Some Anomalous Evidence Regarding Market Efficiency"[1] for the purpose of bringing together a number of scattered pieces of anomalous evidence; this resulted in a strong case being made to review the general acceptance of the Market Model, and to encourage researchers to search for a more precise equilibrium model for the determination of asset prices under uncertainty. These professors suggested that the writer conduct a study to determine whether such variables as D/P ratio, E/P ratio, and firm size explain unsystematic returns of firms in Canada, as an extension to similar studies which have been conducted mainly on U.S. data.[2]

Chapter II explains some of the theoretical background to the Capital Asset Pricing Model, and its offspring the Market Model used in this thesis. The null and alternative hypotheses are defined. Chapter III is a condensed version of the Mulder (1980) literature review, and, in addition, several papers published since then have been added which are relevant to the firm-specific factors under consideration. In Chapter IV the writer details the methodology adopted with some space given to explaining why alternate methodologies were rejected. A potpourri of information - some relevant and some of general interest - concerning the data base have been included in four appendices. Chapter V is perhaps the most interesting and challenging part of the thesis, in which an attempt is made to interpret the not-so-straightforward results. In Chapter VI the entire exercise is wrapped up into some concise paragraphs, and an attempt is made to clothe the numbers and relatively theoretical interpretations in such a manner that they will become meaningful to the real world of the investor.

NOTES

1. Jensen (1978: 95-101).
2. The writer prepared two preliminary reports on a literature survey and proposed methodology from September 1980 to April 1981, and defended his methodology paper in a Finance 562 class on 26 March, 1981. He made his thesis proposal to Drs. Tiniç and Beveridge on 9 October 1981, and his defence to Drs. Tiniç, Beveridge and Timourian on 7 March, 1983.

CHAPTER II

THEORY

The Market Model

The Market Model proposes that the return on any risky security or portfolio, i, is generated by the linear equation,[1]

$$\tilde{R}_{it} = \alpha_i + \beta_i \tilde{R}_{mt} + \tilde{e}_{it}$$

where,

$\tilde{R}_{it}$ = the return on the risky security or portfolio, i, at time t.

$\alpha_i \doteq E(\tilde{R}_{it}) - \beta_i E(\tilde{R}_{mt})$

β_i = the covariance between $\tilde{R}_i$ and $\tilde{R}_m$, divided by the variance of $\tilde{R}_m$; commonly referred to as the beta coefficient for security or portfolio, i.

$\tilde{R}_{mt}$ = the return on a market portfolio of risky assets at time t.

e_{it} = the deviation of $\tilde{R}_{it}$ from its conditional expected value, $E(R_{it}|R_{mt})$, and, thus, independent of the return on the market portfolio, $\tilde{R}_{mt}$.

If returns are generated by the Market model, then an efficient market will recognize this fact and set prices at the beginning of the period such that[2]

$$E(\tilde{R}_{it}|\phi_{t-1}) = \alpha_i + \beta_i E(\tilde{R}_{mt}|\phi_{t-1})$$

where,

ϕ_{t-1} = the set of information available or the "state of the world" at time t-1.[3]

Assuming that the firm-specific unsystematic risk factors, e_{it}'s, can be diversified away, they are not priced in the market; that is $E(\tilde{e}_{it}|R_{mt}, \phi_{t-1}) = 0$. In other words, the systematic risk, β_i, completely captures the contribution of security or portfolio, i, to the risk of m.[4]

On the other hand, if $E(\tilde{e}_{it}|\tilde{R}_{mt}, \phi_{t-1}) \neq 0$ then the effects of firm-specific information will show up in the disturbance term, $\tilde{e}_{it}$.[5] In this case, it may be concluded that either the market is inefficient and/or risky

securities are not priced in the market place in the manner proposed by the Market Model. In other words, returns on risky assets are not strictly a function of systematic risk as measured by the Market Model.

Hypothesis

The basic problem to be explored in this thesis using a combination of ex ante and ex post Canadian data is this: are such firm-specific variables as dividends (D_i), earnings (E_i), and firm size (S_i) important to a portfolio of risky securities' expected rate of return within the context of the Market Model? Are these explanatory variables fully captured by a portfolio's beta coefficient? The purpose is to test the ex post return generating Market Model using Canadian data.

The null hypothesis is:

$$H_o\colon E(\tilde{R}_{it}|\phi_{t-1}) = \alpha_i + \beta_i\, E(\tilde{R}_{mt}|\phi_{t-1})$$

and the alternative hypothesis is:

$$H_a\colon E(\tilde{R}_{it}|\phi_{t-1}) = \alpha_i + \beta_i E(\tilde{R}_{mt}|\phi_{t-1}) + \gamma_1 E(D_{it}|\phi_{t-1})$$

$$+ \gamma_2 E(E_{it}|\phi_{t-1}) + \gamma_3 E(S_{it}|\phi_{t-1}) + \Sigma_{it-1}$$

where Σ_{it-1} captures the effects of all other firm-specific information at time t-1 which has not been specifically examined in this thesis.

This is a model in which the predicted error after extracting all market-wide effects is:

$$E[\tilde{R}_{it} - E(\tilde{R}_{it}|\tilde{R}_{mt})\phi_{t-1}] = E\ (\tilde{e}_{it}|\phi_{t-1}) = \gamma_1 E(D_{it}|\phi_{t-1})$$

$$+ \gamma_2 E(E_{it}|\phi_{t-1}) + \gamma_3 E(S_{it}|\phi_{t-1}) + \Sigma_{it-1}$$

If the predicted error is not significantly different from zero, that is, $E(\tilde{e}_{it}|\phi_{t-1}) = E(\tilde{e}_{it}) = 0$, then the dual null hypothesis that

1. the market is informationally efficient, and
2. the Market Model completely specifies asset price determination

cannot be rejected. If it is assumed that the marked is informationally efficient (at least at the weak and semi-strong levels), then it is the Market Model which is being tested to determine whether an investor can use other data in addition to beta to estimate the return on a portfolio of Canadian securities - all within the framework of the return generating function.

Relationship of the Market Model to the Capital Asset Pricing Model

The original Sharpe-Lintner Capital Asset Pricing Model (CAPM) is as follows:[6]

$$E(\tilde{R}_{it}|\phi_{t-1}) = (1 - \acute{\beta}_i)R_F + \acute{\beta}_i E\ (\tilde{R}_{Mt}|\phi_{t-1})$$

where,

$E(\tilde{R}_{it}|\phi_{t-1})$ = the expected return on the risky security or portfolio, i

$E(\tilde{R}_{Mt}|\phi_{t-1})$ = the expected return on the true value-weighted market portfolio of all risky assets[7]

R_F = the riskless short-term interest rate

$\acute{\beta}_i$ = the covariance between $\tilde{R}_i$ and $\tilde{R}_M$, divided by the variance of $\tilde{R}_M$; commonly referred to as the true beta coefficient for security or portfolio, i

The assumptions of the CAPM are as follows:

1. Investors are risk-averse expected utility maximizers who base their decisions on the expected returns and standard deviations of returns on risky assets or portfolios of risky assets;

2. Investors have one-period time horizons, and homogeneous expectations;
3. Investors have the ability to borrow and lend unlimited amounts at the risk-free rate of interest, R_F;
4. Investors live in a world devoid of taxes and transactions costs; and
5. No single investor can affect the price of securities by his or her own investment decisions.

Testing the CAPM by itself is really quite difficult, and it is generally concluded that the following triple null hypothesis must be tested jointly:

1. The market is informationally efficient, and
2. The CAPM completely specifies asset price determination, and
3. The market proxy, m, is a valid measure of portfolio M.

The tests can fail because one or two or all three of these hypotheses is or are false. This limitation certainly weakens the power of any statistical tests to discern whether, for example, the second part of the null hypothesis above is or is not invalid. In addition, because the CAPM postulates ex ante relationships between returns and risk, a

completely clean empirical test of the CAPM would require the availability of data regarding investor's expectations. In the absence of such data researchers have been forced to use historical data. Tinic and West offer the following consolation concerning this problem:

> ... researchers... have assumed that the average of the differences between expected returns and realized returns has not been statistically different from zero. In efficient markets, this assumption seems to be quite reasonable over long periods of time. When the equilibrium prices of securities reflect all available information, it is logical to expect that even though realized yields will likely differ from expected yields from period to period, the average of these differences over time will be quite close to zero.[8]

Since a researcher can only study a return generating model of observables, it should be pointed out again that it is not possible to test the Sharpe-Lintner CAPM directly. Besides, R_M, the true market portfolio, is an abstract portfolio which is supposed to contain <u>all</u> risky assets in proportion to their relative value in the total marketplace.[9] Since a perfect counterpart to R_M is very difficult to obtain in the real world, a surrogate market portfolio must be used. Although the majority of researchers in the literature review are of the opinion that whenever the research results forced a rejection of the null hypothesis it was due to a misspecification of the CAPM, both Fama and Roll have pointed out that if a test does not use the true market portfolio, M, the Sharpe-Lintner CAPM

might be wrongly rejected.[10] Since it is the Market Model which is being tested in this thesis, however, one of the hypotheses in the triple null hypothesis applicable to the CAPM can be relaxed; namely, that the market proxy, m, is a valid measure of all risky assets in the marketplace.[11]

If the CAPM is true and R_m is a reasonably good proxy for R_M, this would increase one's faith in the validity of the Market Model. But the Market Model as a return generating function can describe the expected returns of a security or portfolio of securities even if the CAPM is false. If the stock market, for example, is pricing systematic risk and the beta coefficient of a stock or portfolio of stocks is its co-movement with the stock market, m, then the Market Model is valid. In addition, it may also hold for other unknown reasons. Hence, the Market Model which is being tested in this thesis is independent of the accuracy of the CAPM from which it is derived.

The literature has a tendency to refer to the CAPM as being tested when in fact it may be the Market Model. In the review of the literature which follows, the writer has conformed to the original wording in the literature sited with respect to references to the CAPM.

Notes

1. Tiniç and West (1979: 278-296, 306) and Fama (1976: 152, 368).

2. Fama (1976: 151).

3. Ibid (1976: 134-135).

4. Ibid (1976: 77).

5. Idem

6. Tiniç and West (1979: 278-296) and Fama (1976: 368).

7. All common stocks, preferred stocks, bonds, commodities, etc.

8. Tiniç and West (1979: 305).

9. Ibid (1979: 289).

10. Ibid (1979: 316, 320). In addition, Ball (1978: 111-112) reminds us

    > ..., the above comments on the possibility of omitted variables in the two-parameter model apply equally to the formulation where an imperfect measure of total wealth is used. Without using data in addition to common stock returns, it would not be possible to distinguish two alternative sources of the anomaly: variables omitted from the model, or spurious variables introduced by an imperfect measure of total wealth.

11. Fama (1976: 370) states

    > ..., there is little doubt that m, the equally-weighted portfolio of NYSE stocks, is substantially more risky than M, the value-weighted portfolio of all investment assets... In truth, all we can really say at this time is that the literature has not yet produced a meaningful test of the Sharpe-Lintner hypothesis.

    Also, refer to Chapter V of this thesis.

CHAPTER III

LITERATURE REVIEW

Scope

During the fall of 1980 the writer conducted a literature review of twenty papers circa 1972 to 1979 from a variety of finance and economics journals and three unpublished theses.[1] The purpose of this review was to become familiar with the body of literature which suggests that a stock's beta-risk may not fully capture such variables as dividends, earnings, firm size, financial leverage, rate of inflation, and changes in GNP. At the end of 1980 and early 1981, the writer was advised to limit the number of explanatory variables to the first three mentioned above, due to limitations and complexities in the available Canadian data, and a need to limit the scope of the research to that of a master's thesis. Later in 1981 the writer reviewed three recently published papers dealing with the three explanatory variables under consideration.[2]

The available literature indicates that the great majority of the research has been on U.S. data from 1926 to 1977. The only exceptions are the paper by Morgan (1979) which includes returns on common stocks on the TSE from 1963

to 1977, and the paper by Ball (1978) in which three of the fifteen studies in his literature review used Australian data from the Melbourne Stock Exchange.

Dividends

Brennan (1970) developed and tested a market equilibrium model which takes into account the diversity of U.S. investors' marginal tax rates. The author examined the relationship between dividend yield and beta risk for all securities on the NYSE from 1946 to 1965; he concluded that the higher is an asset's dividend yield, the higher is its equilibrium before-tax expected return due to the higher tax rate levied on dividends than on capital gains. To the extent his model fits the observed data over the period studied better than does the simple Sharpe-Lintner CAPM, he was unable to reject his null hypothesis that for a given level of risk investors require a higher total return on a security the higher is its prospective dividend yield. In an extension of Brennan's model to account for constraints on borrowing and a progressive tax scheme, Litzenberger and Ramaswamy (1979) using U.S. data over the period 1936 to 1977, supported Brennan's findings. Litzenberger and Ramaswamy conclude that for every dollar increase in return in the form of dividends, investors require an additional 23 cents in before-tax return. In addition, they found

evidence for a clientele effect that stockholders in higher tax brackets choose stocks with low yields, and vice versa.

Bar-Yosef and Kolodny (1976) arrive at similar conclusions using a variety of testing procedures. They attempted to determine whether dividend policy is relevant to the valuation of securities in light of recent developments in capital market theory, and rejected their null hypothesis at the 0.05 percent level that U.S. industrial and utility firms (over the periods 1963 to 1971 and 1953 to 1971, respectively) with different dividend payout policies have the same return and risk characteristics. These authors believe that the practial use of the simple Sharpe-Lintner CAPM has limitations, since knowledge of a firm's dividend policy makes a significant contribution to explaining the return on a firm's security. They recommend that "... the CAPM should be modified or an alternative model used to eliminate the bias..."[3] when using this model for empirical testing and suggest including a dividend policy variable. These conclusions were supported by Charest (1978) who analysed the risk and return behaviour of NYSE common stocks around dividend changes for those stocks quoted for at least five years over the period 1947 to 1968. Charest concluded that the simple CAPM may omit important factors and produce incorrect residuals; the latter would be correlated with the yield surrogate (dividend changes) because these surrogates

would proxy for the omitted factors reflected in the residuals.

Morgan (1979), using a portfolio matching technique, studied monthly returns on common stocks on the NYSE from 1926 to 1977 and on the TSE from 1963 to 1977 to present evidence for a difference in the behaviour of returns during months in which dividends were paid and were not paid. The author obtained positive residuals in dividend paying months and negative residuals in the following month. Morgan rejected his joint null hypothesis that the market is informationally efficient with respect to the ex-dividend date during month t, and that equilibrium prices are determined by the simple CAPM.

Contradictory results have, nevertheless, been found. Black and Scholes (1974) attempted to determine whether the Sharpe-Lintner CAPM holds equally for stocks at all levels of dividend yield. Using monthly data for every stock listed on the NYSE at any time from 1926 to 1966 and a portfolio-matching technique, the authors were unable to reject their null hypothesis that increasing the dividend will reduce the expected return on a company's shares. They concluded that there are no differential returns earned by investors who buy high or low dividend yielding securities for portfolios of equal risk. In other words, they claimed empirical support for one of the underlying assumptions of the CAPM that on average a dollar of dividends has the same

value as a dollar of capital gains. In this connection, it is of interest to note that subsequent unpublished research in 1978 by Rosenberg and Marathe[4] attribute a lack of statistical power to the Black-Scholes tests due to a loss in efficiency from grouping stocks into portfolios and an inefficiency in their OLS procedures. Using the same data as did Black and Scholes, Rosenberg and Marathe found that the coefficient of the dividend yield is statistically significant. Morgan in commenting on the Black-Scholes paper states that, "... because of low statistical power, the evidence cannot be interpreted as rejecting the negative effect or even the positive effect view."[5] And finally, in a recent paper by Blume (1980), the author uses a cross-sectional regression method of the CAPM which includes an anticipated dividend yield variable and reexamines the findings of Black and Scholes. Blume's analysis revealed that from 1946 to 1976 those stocks with anticipated dividend yields in excess of the mean market-wide yield outreturned non-dividend paying stocks at each level of beta. Interestingly, the author concludes that

> Another interpretation of the results is that the Sharpe-Lintner [capital asset pricing] model is too restrictive and that dividend yield is acting as a surrogate for some unspecified variables omitted from this model. Indeed, there is a growing body of evidence consistent with this proposition.[6]

On the basis of the above review of the current literature, there is strong support for the hypothesis that

a firm's dividend policy has a significant effect on the firm's expected return which is not captured by the simple Sharpe-Lintner CAPM. On the basis of this research on primarily U.S. data, the dividend payout ratio has been included as an explanatory variable in the writer's corresponding analysis of purely TSE data.

Earnings

Basu (1977) studied an average of 500 industrial firms on the NYSE from 1956 to 1969 to determine whether investment performance of common stocks is related to their P/E ratios. The author ranked the securities according to their P/E ratios, formed five portfolios, and then compared the risk-return relationships of these portfolios using two specifications of the CAPM. Basu discovered that, contrary to capital market theory, the low P/E portfolios earned significantly higher rates of return than the high P/E ratio portfolios which were not associated with higher levels of systemic risk. The author assumed, however, that the CAPM is valid, and that a violation of the joint hypothesis is explained in terms of market inefficiency due to lags and frictions in the impoundment of publicly available information in security prices.

Watts (1978) studied 73 NYSE securities over the period 1950 to 1968. Using quarterly earnings per share data and

an equal-risk portfolio-matching technique similar to that used by Black and Scholes, the author calculated abnormal returns as the difference in returns between the two portfolios. The author arrives at inconclusive results, since his abnormal returns exist only during the period 1962 to 1965 but not from 1965 to 1968. Watts rejects his hypothesis that earnings forecast errors proxy for omitted variables in the CAPM, but, nevertheless, expresses some reservations in implying that the market was inefficient during the period 1962 to 1965.

Ball (1978) summarizes the research up to 1977 on the effect of various measures of earnings yield on stock yields. His literature review covers research conducted mainly on U.S. data, with the exception of three of his fifteen studies being based on Australian data from the Melbourne Stock Exchange. Ball points out that this earlier research indicates that security prices yield, on average, systematic excess returns in earnings post-announcement periods. This leads him to conclude that this consistent anomaly is more supportive of the model misspecification hypothesis than of any other. Since Ball noticed the different effects of earnings as compared to the P/E ratio, he is able to reconcile the inconsistent results of Basu and Watts. Ball concludes that studies whose experimental design is based on P/E ratios induce larger differences in security expected returns than those studies based on

earnings per share. This latter conclusion has been confirmed by a recent paper by Reinganum (1981) who uses a portfolio-matching procedure on 535 NYSE and ASE firms from 1975 to 1978. Reinganum was unable to obtain abnormal returns significantly different from zero by constructing portfolios on the basis of a firm's standardized unexpected earnings per share. On the other hand, he discovered persistent abnormal returns using portfolios based on a firm's quarterly and annual E/P ratios; the average returns for high E/P securities are greater than the average returns for low E/P securities of equivalent beta risk. Mainly on the basis of the persistence of these abnormal returns, he concludes that the simple CAPM incorrectly specifies the equilibrium pricing mechanism, rather than capital markets being informationally inefficient.

On the basis of the above review of the literature, there is strong support for the hypothesis that the simple Sharpe-Lintner CAPM does not fully capture the effect of changes in earnings, especially as expressed in the form of the P/E ratio.[7] The excess returns found in the research conducted primarily on U.S. data probably results from earnings proxying for omitted variables in the simple CAPM. The weight of evidence indicates that by expressing the earnings variables in the form of a P/E ratio (or its inverse) a gross market model misspecification can be detected. Since similar research has not to the writer's

knowledge been conducted on Canadian data, the E/P ratio has been included as an explanatory variable in the writer's thesis.

Firm Size

Two recent papers present direct evidence on the effect of firm size on a firm's return as estimated by the simple CAPM. Banz (1981), using an expanded asset pricing model and constructing arbitrage portfolios, examined the empirical relationship between the return and the market value of all common stocks quoted on the NYSE for at least five years between 1926 and 1975. The results of Banz's research suggests the existence of a partially segmented market with higher expected returns for stocks of small firms (especially very small firms) than for larger firms of equivalent beta risk over the 40 year period studied. Although he does not admit that firm size per se is responsible for the higher risk-adjusted returns,[8] he concludes that this is evidence that the simple linear CAPM is misspecified.

Reinganum (1981) continues his own research into misspecifications of capital asset pricing,[9] and, encouraged by Banz's work, the former investigated whether the size anomaly and the E/P anomaly are two independent effects or whether both anomalies proxy for the same missing values

during the period 1963 to 1977. Reinganum discovered that, after controlling returns for any E/P effect, a strong firm size effect emerged; but, after controlling returns for any firm size effect, a separate E/P effect was not found. While an E/P anomaly and firm market-value anomaly exist when each variable is considered separately, the two anomalies seem to be related to the same set of missing factors, and these factors appear to be more closely associated with firm size than with E/P ratios. He concludes that the simple CAPM is misspecified.

Since the literature has revealed evidence from U.S. data that the simple Sharpe-Lintner CAPM does not fully capture the effect of differences in firm size as related to the dependent variable in the CAPM, firm size as expressed by a firm's equity capitalization value has been included as an explanatory variable in the writer's comparative analysis using Canadian data.[10]

NOTES

1. Mulder (1980).
2. Banz (1981), Blume (1980), and Reinganum (1981).
3. Bar-Yosef and Kolodny (1976: 189).
4. Litzenberger and Ramaswamy (1979: 164).
5. Morgan (1979: 1).
6. Blume (1980: 577).
7. Lev (1974: 20) confirms the findings of the previous researchers when he states that "The PE ratio as conventionally calculated (i.e., using past earnings) is thus an indicator of the future earnings prospects of the firm, as anticipated by the market."
8. The higher risk-adjusted returns could be acting as a proxy for one or more unknown factors correlated with firm size.
9. Continues his research which originated as a 1979 Ph.D. dissertation. The writer has his third revision dated Nov., 1978.
10. Banz (1981: 17) concludes his paper by stating, "Further research should consider the relationship between size and other factors such as dividend yield effect, ...".

CHAPTER IV

METHODOLOGY

Background

It was realized at the outset that a wise choice of methodology for testing the hypothesis was subject to several constraints; namely, the availability of the data, and the scope limitations of an MBA thesis. Since there exists a paucity in the quantity and quality of Canadian data relative to U.S. data, this prevents the wholesale adoption of some of the more powerful methodologies which have recently been developed to test the Market Model on U.S. data.

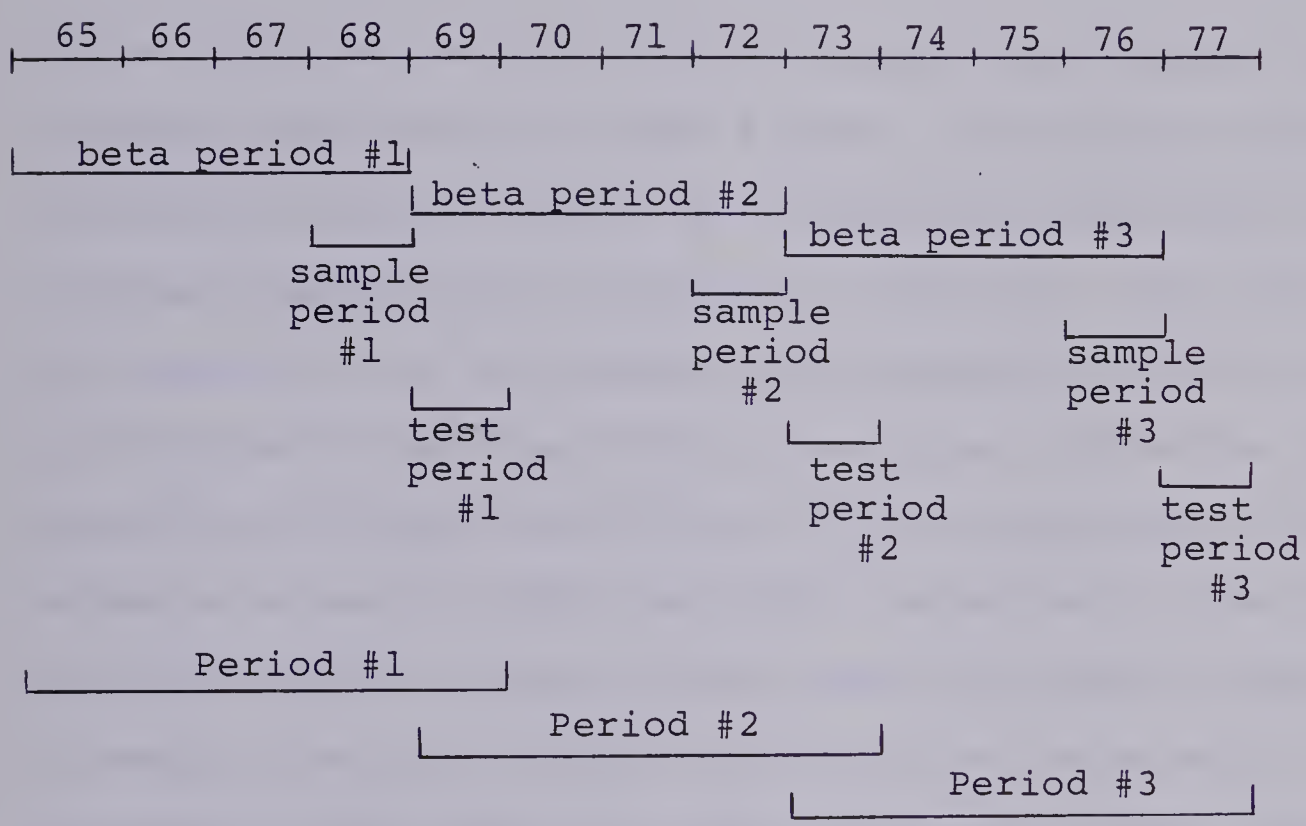
Early in 1981 the writer investigated the possibility of using the Financial Post (TSE) tape from the University of Alberta BAC:BAC.DATA Retrieval System, in order to obtain quarterly dividends. By obtaining quarterly earnings from other sources, ex post data would be used to run regressions on an expanded version of the Market Model for individual securities. A preliminary search indicated that, due to poor availability and continuity of quarterly earnings back to 1965, the data base would be reduced considerably. In addition, the quality of quarterly earnings is suspect since

they are normally unaudited.[1] Hence, the methodology above was abandoned, and a less statistically powerful methodology using portfolios in lieu of individual securities was adopted.[2]

Sample and Test Periods

Since the weekly data in the Financial Post (TSE) tape in the University of Alberta BAC:BAC.DATA Retrieval System covers the period from the first week of 1965 to the 26th week of 1979, the use of this tape as the primary data base over this 14 ½ year period places some restrictions on the methodology and necessitates that compromises be made to determine the length of period for calculating betas. In order to obtain three widely spaced test periods during this time span and maintain a four year period to estimate beta, the data base was segmented as depicted in Figure 1. It does not matter when Period 1 begins or Period 3 ends, since only 6.2% of the securities are missing during the first week of 1965 and only 3.3% terminate during calendar year 1978. Upon reviewing some of the possible combinations of test periods, the following four options were considered under the constraint of a four year period to estimate beta:

FIGURE 1: Segmentation of Data Base Into Periods



1.	1969	1973	1977
2.	1969	1973	1978
3.	1969	1974	1978
4.	1970	1974	1978

Since 1974 was a severe recession year it was decided to eliminate options nos. 3 and 4 above. In forming a two-parameter portfolio matrix by grouping the securities into various combinations of D/P ratio, E/P ratio, and firm size for option no. 3, for example, the abnormal returns in 1969 and 1974 would both be during recessions. Since the firm-specific variables for 1968 and 1973 are estimates of the expected values for 1969 and 1974, respectively, they would probably not be realized during these bear-market years. As a result, they may be poor measures of an investor's expected values during the following test periods. Option no. 1 was selected mainly because the sample-test year pairs are the least disruptive; that is, 1968-69, 1972-73, and 1976-77 contain only one recessionary test period, 1969, which was a milder recession than was 1974.

Data and Sample

Test Period Data Base

On the basis of the foregoing discussion, it was decided to adopt the Financial Post (TSE) tape of weekly data as the primary data base, which is identified as tape no. 1 in the BAC:BAC.DATA Retrieval System at the University of Alberta. This tape contains weekly closing prices and adjusted returns with or without dividends for 307 TSE common stocks for the 14 ½ year period from the first week of 1965 to the 26th week of 1979. In addition, this tape also lists dividends during the week of the ex-dividend date, and stock splits when they occur. In order to calculate weekly portfolio returns for the same securities in each of the three test periods, it was decided that only those securities with continuous returns with dividends throughout all three test periods would be included. Only 224 out of the total of 307 securities survived this constraint.

Sample Period Data Base

Dividend/price ratios

The above mentioned Financial Post (TSE) tape provided both the numerator and denominator to calculate these ratios. Further information on this data base can be found in Appendix A.

Earnings/price ratios

Unfortunately, a complete file of annual earnings per share (EPS) data was not available on any one computer tape, which resulted in a considerable amount of time spent collecting and manipulating these data manually. Since annual earnings per share data could not be obtained for three securities[3] in the Financial Post (TSE) tape, this reduced the data base from 224 to 221 securities for the All-firm Sample.

Table VI, panel (a) on page 75 lists the sources used to obtain EPS data, and are ranked in the order of priority used. The Compustat-Can file contains annual financial statements for 288 Canadian companies from 1960 to 1979, inclusive, and is identified as tape no. 6 in the BAC:BAC.DATA retrieval System at the University of Alberta. The second priority source is the Financial Post

Corporation Service pamphlets (F.P. Cards). When EPS data were either unavailable from either one of the two previous sources or else in error from the F.P. Cards, other sources of EPS data were resorted to in order to maximize the size of the data base. These sources were personal communications with senior company representatives, annual reports, the Canadian Financial Information Library(CAN/FIL) microfiche file, and Standard and Poors Stock Guides. Further details concerning these sources are described in Appendix B and in Chapter V of this thesis.

Firm Size

The sources from which the number of common shares outstanding as of December 31 (used in the surrogate for firm size) were obtained are generally the same as were used to obtain earnings per share. Letters were sent to eight companies (100% response, fortunately!) for this information which was not available from any readily available published sources. Further information on this data base is included in Appendix C.

Calculation of Firm-Specific Variables

D/P Ratio

The various definitions of dividend yield employed by previous researchers as gleaned from the literature survey are presented first, in order to arrive at an appropriate definition which can be conveniently derived from the Financial Post (TSE) tape. Particular attention is focused on the time relationship between the numerator and denominator.

Brennan (1970) simply defines "the prospective dividend yield on security j" as dj/pj.[4] Black and Scholes (1974) state that they use the "... dividends paid in the last year of the five years, and the price at the end of the fifth year, in estimating the dividend yield of a security."[5] Litzenburger and Ramaswamy (1979) define the "... dividend yield variable..." as Dit/Pit-1.[6] Blume (1980) calculates his dividend yield as a measure of anticipated future dividend yield as the ratio of dividends paid over the previous twelve months to the price at the beginning of the twelve month period. He then adjusts his beginning-of-year price for market-wide changes as measured by Standard and Poor's Composite Index. Blume tested the forecasting accuracy of this method versus that of Black and Scholes over various sub-periods from 1927 to 1976, and discovered

little difference in mean squared errors from 1952 to 1976 (0.00100 for Blume versus 0.00123 for Black and Scholes).[7]

The review of the literature indicates that it makes little difference how the D/P ratio is defined as used for forecasting purposes. After some discussion concerning the merits of Blume's definition, it was decided to define the annual D/P ratio as the sum of the dividends per share paid over the year divided by the end-of-year price per share where the year is the sample period prior to the test period. This is a common practice in the investment financial community; that is, to use the most recent price per share in the denominator for forecasting purposes.[8] Further details concerning the methodology of calculating the D/P ratio is included in Appendix A.

E/P Ratio

Basu (1977) defined his P/E as follows: "The numerator... as the market value of common stock (market price times number of shares outstanding) as of December 31 and the denominator as reported annual earnings (before extraordinary items) available for common stockholders."[9] Reinganum (1981) calculated annual E/P ratios as "... annual income _after_ extraordinary items and discontinued operations divided by the value of the common stock... as of December 31."[10] Only firms with positive earnings and whose fiscal

year-end month was December were included in his data base. It is interesting to note that previously the author analyzed E/P portfolio performances using four different measures of earnings, and discovered that the results were robust with respect to the earnings measure.[11]

On the basis of the foregoing, the same principle was used to define the annual E/P ratio as was used to calculate the D/P ratio; that is, the annual earnings per share before extraordinary items[12] was divided by the end-of-year price per share where the year is the sample period prior to the test period.[13] A detailed discussion of the methodology of calculating the E/P ratio and some of the data problems is included in Appendix B.

Firm Size

Banz (1981) uses "Stock price and the number of shares outstanding at the end of the five year periods..."[14] to calculate the market value of his stocks. Reinganum (1981) defines Banz's measurement of firm size as being "... the aggregate market value of the firm's common stock ..."[15] and his own measurement as simply a firm's "... December 31 market values ..."[16]

On the basis of the foregoing, the writer estimated the size of each firm in terms of the firm's equity capitalization value by multiplying the number of common

shares outstanding as of December 31 by the end-of-year price per share. Further information on this data base has been included in Appendix C.

Construction of Portfolio Matrices

The portfolios in the first matrix were formed by first ranking all the securities from minimum to maximum D/P ratio and then grouping this array into three equally sized classes of D/P ratio. Next, the securities in each of the three low, medium and high D/P categories were ranked from minimum to maximum E/P ratio and then grouped into the same three equal categories of E/P ratio. This was done for each of the three periods. The result was a nine portfolio matrix for each period. Since the same securities were used for each period, the three portfolios are identical with regard to the number of securities represented in each portfolio. The individual securities may, of course, not necessarily be represented in the same portfolio over all three periods, due to changes in D/P and E/P ratios over time. The sample using the maximum number of securities with continuous data across all three periods (221 out of a maximum possible of 307 in the Financial Post (TSE) tape) has been referred to simply as the "All-firm Sample," which has a total of 24 to 25 securities in each of the nine portfolios in each period.

One change made early in the research was to create a second sample for only those securities whose fiscal year ended at or close to December 31. This was the practice adopted by Basu[17] and Reinganum.[18] The advantages of selecting this second sample are as follows:

1. The annual earnings per share figures are more accurate, and, therefore, more representative of a firm's performance than those which must be calculated by prorating and adding two year's earnings figures to obtain an estimated earnings per share for a fiscal year which coincides with a calendar year.[19] As was explained earlier, quarterly earnings data were not readily available.
2. An earnings figure which overlaps a test period extends its influence into the test period, and tends to bias this firm-specific variable since it is based on more information than the market would have. Hence, this sample bias may strengthen the effect of the E/P ratio in contributing towards an abnormal return, as well as the magnitude of the abnormal return itself.

The disadvantage of the second sample, of course, is the simple fact that it represents a smaller sample. The paucity of readily available Canadian data is a fact which has already been mentioned, and reducing the number of securities in each portfolio from the 24-25 to the 16-17

level reduces the statistical power of the tests. Nevertheless, this tradeoff was deemed desirable. Due to changes in fiscal year-ends for some securities and an increasing trend for firms to adopt a December 31st fiscal year-end, the number of securities represented each period increased over time; Period 1 had a total of 147, Period 2 had 152, and Period 3 had 153 securities. This sample has been referred to simply as the "Calendar-year Sample."

Since three firm-specific variables were selected to determine which, if any, show up in the error term of the Market Model but only two of these variables can be tested together at one time, it was necessary to construct several sets of portfolio matrices across all three periods for various dual combinations of the three firm-specific variables. An interesting question arises whether it makes any difference to the results for any of the three possible combinations[20] as to which variable is used first to rank the securities. If it is suspected that the order in which the securities are ranked will cause a significant difference in the results, then a total of six sets of portfolio matrices[21] across the three periods (for a total of 18 portfolio matrices or 162 individual portfolios excluding the marginal portfolios) would be required. A review of the literature indicates that two researchers have taken the trouble to answer this question empirically. Blume (1980) hypothesized that by grouping his NYSE

securities first according to betas and secondly by dividend yields, he would obtain less variability in dividend yields (than if he had grouped by dividend yields first) and bias his tests against finding a dividend effect. He estimated all his cross-sectional regressions both ways and discovered that "... the results appear fairly robust to the order of grouping."[22] Banz (1981) formed his 25 portfolios by ranking his securities first on the basis of market value and secondly on the basis of their beta. By revising his grouping procedure - ranking first according to beta, and secondly by market value - he discovered that this "... does not lead to substantially different results."[23]

Security Betas

In order to combine the securities within each portfolio, such that each portfolio as a whole has a risk equal to that of the market, it is first necessary to estimate betas for each security in each of the three periods for the 221 securities in the All-firm Sample. This was accomplished by regressing the weekly returns for security, R_i, on the weekly returns on the market, R_m, as follows:

$$\tilde{R}_{it} = \alpha_{it} + \beta_{1i} \tilde{R}_{mt} + \beta_{2i} \tilde{R}_{mt-1} + \tilde{e}_{it}$$

where $\beta_i = \beta_{1i} + \beta_{2i}$

β_i was subdivided into two components in order to account for the fact that some securities on the TSE are thinly traded, and the returns for these securities may be adjusting for what occured during the previous week, t-1. Although weekly prices for thinly traded securities for the CRSP and Laval (TSE) tapes were calculated as the average of the bid and ask prices on a Friday when no trades were made, this may not have been done for the Financial Post (TSE) tape.[24] Hence, the price for the last trade during the week may have been used instead.

Unfortunately, a computer file of weekly market returns for the TSE was unavailable at the University of Alberta. Hence, a file of equally weighted weékly market returns was created using the returns with dividends for all securities over the entire time period of the Financial Post (TSE) tape. The weekly market returns were calculated as follows:

$$R_{m,t} = \frac{1}{n} \sum_{i=1}^{n} R_{i,t},$$
$$t = 65/1,\ 65/2,\ \ldots,\ 65/52$$

The value of 'n' ranged from a maximum of 304 in 1967 to a minimum of 230 in 1977 over this 13 year period, where 'n' is the total number of securities whose returns are available during each one week holding period.

Concerning the historical period for estimating security beta coefficients, a recommended general guide is

to use from five to seven years of monthly return data in the regressions.[25] Unfortunately, none of the available Canadian data files affords this luxury, and to obtain anything less than three widely-spaced test periods would have been regrettable. Although this trade-off was at the expense of a shorter beta-estimation period, it can be argued that the weekly returns will permit a shorter historical period for estimating betas. For the majority of the securities, four years of return data were used to estimate betas except for the first period when seven securities[26] and estimation intervals ranging from three years, 41 weeks to two years, 49 weeks. As Tiniç and West (1979) have stated "... common sense, rather than a blind adherence to any rule of thumb, should be the guiding principle to selecting the length of a time period."[27]

The actual calculation of the beta coefficients was accomplished using the Time Series Processor ordinary least squares (OLSQ) statistical program. A miscellania of items related to the methodology and problems encountered in calculating beta coefficients, and some interpretations of the results, have been placed in Appendix D.

Construction of Market Portfolios

There is more than one way in which the securities within the portfolios can be combined such that the beta of

each portfolio of securities is equal to unity. Two methodologies were considered as gleaned from the literature review: the equally-weighted and the minimum variance method.

The advantage of the minimum variance method is that it minimizes the variance of the single estimate of the portfolio beta, β_p, which has been set at unity.[28] This, in turn, minimizes the standard error of this estimate, and produces the most efficient estimator.[29] Of all the possible estimates of $\beta_p = 1$, the weights obtained using the simple equally-weighted method will yield a value of $\beta_p = 1$ with an unknown variance whose value will be greater than the minimum value, and, hence, not the most efficient estimator. The disadvantage of the minimum variance approach is that it is not a simple methodology and involves the use of Lagrangian calculus and non-linear programming.[30] A review of the literature indicates that this methodology was only used by Black and Scholes (1974).

The equally-weighted approach which was adopted was the same as used by Watts (1978), who used an "abnormal return" methodology similar to the one in this study.[31] The approach as described by Watts is to rank the securities in each portfolio from minimum to maximum beta. This array of securities ranked by beta values is then split equally into two intermediate portfolios: a low beta portfolio and a high beta portfolio.[32] The mean beta for each intermediate

portfolio is calculated as follows using the Calendar-year Sample as an example:

$$\left.\begin{array}{l} \text{minimum } \beta_1 \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \beta_8 \end{array}\right. \qquad \bar{\beta} = \frac{1}{n} \sum_{i=1}^{n} \beta_i \quad n=8 \qquad \text{Low-beta intermediate portfolio}$$

$$\left.\begin{array}{l} \beta_9 \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \text{maximum } \beta_{17} \end{array}\right. \qquad \bar{\bar{\beta}} = \frac{1}{n} \sum_{i=1}^{n} \beta_i \quad n=9 \qquad \text{High-beta intermediate portfolio}$$

After calculating the mean betas for each intermediate portfolio the weights x and (1-x) on the low-beta and high-beta intermediate portfolios, respectively, were estimated as follows:[33]

$$x\bar{\beta} + (1-x)\,\bar{\bar{\beta}} = 1$$

The purpose of estimating these weights is, of course, to combine the two intermediate portfolios into a single portfolio of weekly returns with a beta equal to that of the market, in order to calculate the abnormal returns as the difference between the return on the portfolio and the market return.[34] It must be realized, however, that despite every effort to produce a portfolio with a beta of one, the post-sample betas will not necessarily be the same as in the

sample period. A casual comparison of betas for individual securities across all three test periods indicated some marked non-stationarities over time.[35]

Estimation of Abnormal Returns

Once the weighting factors and mean beta values for the intermediate portfolios are calculated, these and the identification of the securities, the particular pair of intermediate portfolios, the file of security weekly returns, and the equally-weighed return on the market are used as input to a short FORTRAN program which estimates the abnormal returns.

First, the mean weekly returns of the securities in both the low and high beta intermediate portfolios are calculated as follows, again using the Calendar-year Sample as an example:

$$\bar{R}_t = \frac{1}{n} \sum_{i=i}^{n} R_{t,i} \qquad n = 8 \qquad \text{Low-beta intermediate portfolio}$$

$$\bar{\bar{R}}_t = \frac{1}{n} \sum_{i=i}^{n} R_{t,i} \qquad n = 9 \qquad \text{High-beta intermediate portfolio}$$

where $R_{t,i}$ is the return on security 'i', and t varies from the first to the fifty-second week of Test Period #1.

Next, weekly rates of return for the market risk-equivalent portfolios are estimated by applying the weighting factors to the mean weekly returns of the low and high beta intermediate portfolios as follows:

$$R_{p,t,\beta=1} = x\,\bar{R}_t + (1-x)\,\bar{\bar{R}}_t,$$
$$t = 69/1,\ 69/2, \ldots,\ 69/52$$

Finally, the weekly abnormal returns for each week within a specific portfolio are simply estimated as the difference between the above market risk-equivalent portfolio returns and the weekly return on the market as follows:

$$AR_t = R_{p,t,\beta=1} - R_{m,t},$$
$$t = 69/1,\ 69/2,\ \ldots,\ 69/52.$$

The entire procedure is repeated for each of the other eight portfolios within Test Period #1, and then for the other two Test Periods to produce a total of 1404 abnormal returns for all three test periods for each of the two samples, exclusive of the marginal values. The mean and variance of the 52 abnormal returns were calculated for each portfolio cell,[36] as well as for the 156 abnormal returns represented in each marginal portfolio.[37]

The economic meaning of this abnormal return is that it is the difference between how the market as a whole (actually a segment of the most actively traded securities

on the TSE) performed during a particular week compared to how a particular segment of securities performed which fall within a predicted category of D/P - E/P, E/P - firm size, or firm size - D/P levels on a risk-adjusted basis. Abnormal returns are, therefore, estimated within the framework of two firm-specific variables at a time. The purpose is to test the Market Model using Canadian data and determine if an investor can use other data in addition to beta to estimate the return of a portfolio of Canadian securities. If the beta coefficient fully captures any two of the three company-specific variables being tested at one time, the abnormal return will probably not be significantly different from zero; in any case, the dual null hypothesis cannot be rejected. On the other hand, if an abnormal return is significantly different from zero, the dual null hypothesis can safely be rejected.[38] Whether or not the Market Model is incorrectly specified, however, warrants further discussion.

Evaluation of Abnormal Returns

There has been a general trend in the selection of a particular methodology to keep it as simple as practicable. Since the Canadian data base used is relatively small and not as "clean" as desired, it was decided to place more weight on consistent trends which

exist across at least two of the three test periods. It has been hypothesized that local "blips" probably represent "noise" more associated with inadequacies in the data base than with significant error terms in the Market Model.

The general procedure in evaluating the abnormal returns is to proceed from the particular to the general. Univariate t tests[39] of the mean abnormal returns of the portfolios within each test period matrix and the relative distribution of the minimum and maximum mean values provide an initial insight into any relationship between abnormal returns and the particular firm-specific variables being tested. The marginal mean portfolio abnormal returns present a more general view of the trends, and provide some insight into which variable, if any, may be having the greatest effect by holding one constant and allowing the other to vary.

Although the data may not necessarily meet the exact mathematical specifications of the ANOVA model, this statistically powerful test does provide an overall view as well as simultaneously investigate the differences between the means of the abnormal returns from the two populations related to changes in any of the three pairs of firm-specific variables. It was decided at the outset to maintain a consistent format for the three matrices for each test period, in order to be able to conduct a two-factor relicated ANOVA test across all three test periods, and,

therefore, test for interaction effects between each pair of estimators. Although the ANOVA test is robust, the non-parametric equivalent of ANOVA, Friedman's Test, was run as a check. The test statistic for the latter test, which approximates the chi-square distribution, is not as statistically powerful as ANOVA if the data is reasonably close to the assumptions underlying ANOVA.

Finally, in order to eliminate "noise" and only identify consistent trends, the cumulative abnormal returns for each test period were calculated and then aggregated into cumulative average abnormal returns (CAAR) for all three test periods taken together. The CAAR values were plotted and analysed in order to check for short-run phenomena such as sudden changes or persistent drifts, particularly for those groups of portfolios whose abnormal return means are not significantly different from zero. There may exist abnormal returns within a particular portfolio cell which are compensated for later when the market adjusts, and, as a result, are not detected in the statistical results of that portfolio.

NOTES

1. Reinganum (1981: 35) using U.S. data mentions that "... the use of annual earnings should reduce the seasonality embedded in quarterly earnings; ...". Since earnings for Canadian securities typicaly have a strong seasonality (personal communication with Dr. S. Beveridge), the fourth quarter earnings, for example, would be a poor predictor for next year's annual earnings.
2. Litzenberger and Ramaswamy (1979: 164). On the other hand, there are several statistical problems associated with running cross-sectional regressions on an expanded version of the Market Model. Ball (1978: 118) has cautioned as a "... useful rule-of-thumb ... to avoid E/P ratios and dividend yields, since they (being measures of yields) are likely to be ... highly correlated in cross-section with securities' equilibrium expected returns ...". And Blume (1980: 570) advises using a grouping procedure in his cross-sectional regression since "..., it does provide a fairly robust way of handling measurement errors and non-stationarities.... Although the grouping procedure may yield less efficient estimates ...".
3. These were nos. 12 (Auto Electric Service), 249 (BP Canada Inc.), and 304 (Crown Life) in the Financial Post (TSE) tape.

4. Brennan (1970: 422).

5. Black and Scholes (1974: 11).

6. Litzenberger and Ramaswamy (1979: 181-182).

7. Blume (1980: 569-570).

8. This is confirmed analogously by Standard and Poor's Corporation method of deriving their P-E ratio (as stated in any "Stock Guide") "... by dividing current price by estimated new year earnings or last 12 months earnings if no estimate is available."

9. Basu (1977: 664-665).

10. Reinganum (1981: 35).

11. Reinganum (1979: 31).

12. Due to the non-recurring nature of extraordinary items.

13. The writer selected an EPS measure which best typifies economic earnings for forecasting purposes and which is readily available. The E/P ratio chosen is in agreement with the definition provided by Lev (1974) on page 18:

    > ... the amount of earnings allocated to one share of common stock.... The numerator is defined as net income after interest, taxes, and preferred dividends (i.e., available for common), while the denominator represents the number of common shares outstanding (at year-end or as a yearly average).

    Also refer to endnote 8.

14. Banz (1981: 7).

15. Reinganum (1981: 38).

16. Ibid (1981: 38-39).

17. Basu (1977: 664).

18. Reinganum (1981: 21).

19. See Appendix B.

20. The number of combinations is $\frac{3!}{2!(3-2)!} = 3$.

21. The number of permutations is $\frac{3!}{(3-2)!} = 6$.

22. Blume (1980: 571).

23. Banz (1981: 7, 11).

24. Personal communication with Dr. S. Beveridge.

25. Tiniç and West (1979: 179), Watts (1978: 130), and Morgan (1979: 5).

26. Security nos. 16, 168, 211, 221, 238, 253, and 270.

27. Tiniç and West (1979: 179-180).

28. Black and Scholes (1974: 9-10).

29. Black and Scholes (1974: 10) and Harnett (1977: 233).

30. Banz (1981: 14) states that "Simple equally weighted portfolios are used rather than more sophisticated minimum variance portfolios to demonstrate that the size effect is not due to some quirk in the covariance matrix."

31. Watts (1978: 130-131).

32. A variation of the equally-weighted methodology was used by Morgan (1979:6). He split each portfolio on the basis of whether each security beta was greater than or less than the mean beta of the portfolio. Due to the relatively small sized portfolios in the writer's thesis (from 25 to 16 securities, versus all common stocks on

the NYSE and TSE in Morgan's data base), some portfolios will have outliers which will pull the average beta far to one side of the median for the portfolio, thus creating some intermediate portfolios which could be twice as large as its mate. Reinganum (1978: 22 and 1981: 23) uses Watts' methodology since the latter's weighting scheme "... does not rely heavily upon the extreme sample estimate ...". Incidently, Watts (1978: 135) used a relatively small data base consisting of 73 securities split into two unequal portfolios based on positive and negative forecast errors.

33. A review of the literature indicates that Blume (1980: 570) and Banz (1981: 14) adopted this methodology, although both researchers used a cross-sectional regression model.

34. Watts (1978: 141) infers that the calculation of abnormal returns is not particularly sensitive to the weighting methodology. He ran a separate test and calculated abnormal returns "... without weighting the securities ... to produce portfolio β's of one and ... [discovered] ... results very similar to those ... obtained...." by using his equal-weighting scheme.

35. Tinic and West, (1979: 478).

36. The formula used for the variance of the 52 abnormal returns in an individual portfolio cell is:

$$S^2 = \frac{\sum_{t=1}^{52} (AR_t - \bar{X})^2}{n - 1}$$

37. The formula used for the variance of the abnormal returns in a particular marginal portfolio, which averages the 156 abnormal returns in a set of three individual portfolios along a row or column, j, is:

$$S_j^2 = \frac{\sum_{j=1}^{3} \sum_{t=1}^{52} (AR_{j,t} - \bar{X}_j)}{(3)(52) - 1}$$

38. The methodology is an adaptation of that of Watts (1978: 132).

39. Although one would expect to find significant positive abnormal returns in those portfolio cells represented by securities with the highest D/P and E/P ratios, a conservative approach was taken by assuming no _a priori_ trends in the alternative hypothesis for both the univariate and two-sample hypothesis tests of the mean abnormal returns. Hence, two-tailed test statistics were used throughout.

CHAPTER V

EMPIRICAL RESULTS

D/P - E/P Matrix One

Introduction

Since this was the first matrix studied, two additional tests were conducted before proceeding to the other two matrices. First, abnormal returns for both the All-firm Sample and Calendar-year Sample were estimated and compared; the results of the Calendar-year Sample will be emphasized in this analysis. Second, a preliminary test was done to confirm Banz's and Reinganum's findings[1] that firm size is a powerful firm-specific factor contributing to abnormal returns in the Market Model.

Individual and Marginal Portfolio Cells

An analysis of the Calendar-year Sample in Table I panel (a) indicates that, although only one (2%) out of the total of 45 portfolio cells is significant at the 10% level or better, the minimum and maximum values are generally in the hypothesized direction, except for the individual

TABLE I Minimum and Maximum Mean Abnormal Returns ($x10^3$)*

(a)

D/P → / E/P ↓	LOW			MEDIUM			HIGH			MARGINAL		
	1969	1973	1977	1969	1973	1977	1969	1973	1977	1969	1973	1977
LOW	-1.0028 (0.601) Min.	-	-	-	-	-	2.2398 (1.624) Max.	1.7945 (1.376) Max.	-	0.3755 (0.288) Min.	-	-1.6298 (1.438) Min.
MED	-	-	-2.9436 $(2.406)^y$ Min.	-	-	-	-	-	-	-	0.9475 (0.563) Max.	-
HIGH	-	-0.9812 (0.689) Min.	-	-	-	-	-	-	2.3962 (1.632) Max.	0.8518 (0.545) Max.	0.4695 (0.270) Min.	1.7928 (1.322) Max.
MARGINAL	-	-	-1.2705 (0.963) Min.	0.1248 (0.124) Min.	0.3897 (0.277) Min.	-	1.2738 (0.756) Max.	1.1580 (0.753) Max.	0.3083 (0.266) Max.			

(b)

E/P → / F.S. ↓	LOW			MEDIUM			HIGH			MARGINAL		
	1969	1973	1977	1969	1973	1977	1969	1973	1977	1969	1973	1977
LARGE	-1.4740 (0.832) Min.	-1.2430 (0.684) Min.	-3.6588 $(3.061)^z$	-	2.3274 $(1.802)^x$	-	-	-	-	-0.0604 (0.047) Min.	0.3404 (0.245) Min.	-1.1738 (1.361) Min.
MED	-	-	-4.5628 $(2.542)^y$ Min.	2.7243 $(1.886)^x$	-	-	-	-	2.3044 (1.524) Max.	1.2325 (0.902) Max.	-	-
SMALL	-	2.4929 (1.551) Max.	-	-	-	-	3.6422 (1.656) Max.	-	-	-	1.273 (0.839) Max.	0.6789 (0.457) Max.
MARGINAL	-0.3414 (0.231) Min.	1.2034 (0.639) Max.	-2.9742 $(1.731)^x$ Min.	-	0.4941 (0.432) Min.	-	1.4223 (0.768) Max.	-	1.2807 (0.988) Max.			

(c)

F.S. → / D/P ↓	LOW			MEDIUM			HIGH			MARGINAL		
	1969	1973	1977	1969	1973	1977	1969	1973	1977	1969	1973	1977
LOW	-	-1.5434 (0.8948) Min.	-2.8807 $(2.309)^y$ Min.	-0.8890 (0.465) Min.	-	-2.2739 $(1.870)^x$	-	-	-	-	-	-1.5732 (1.133) Min.
MED	-	-	-	-	-	-	-	-	-	-0.3522 (0.291) Min.	-0.0723 (0.061) Min.	-
HIGH	1.8754 (1.429) Max.	3.1808 $(2.342)^y$ Max.	-1.8048 $(1.871)^x$	-	-	-	-	-	1.5994 (1.029) Max.	1.3374 (0.639) Max.	1.9553 (0.872) Max.	0.2542 (0.229) Max.
MARGINAL	0.2503 (0.181) Min.	0.7437 (0.484) Min.	-1.8344 $(1.771)^x$ Min.	-	-	-	0.5842 (0.229) Max.	1.2410 (0.436) Max.	0.3560 (0.219) Max.			

*The t-values are in parentheses. Superscripts x, y and z denote levels of significance of 10%, 5% and 1%, respectively.

portfolio cells and E/P marginal portfolio cells in the 1973 test period. The only pair of minimum-maximum mean abnormal returns which were significantly different from one another was for both the individual[2] and E/P marginal[3] portfolio cells for the 1977 test period; these results indicate a segregation pattern such as to favour the D/P effect in the individual portfolios and the E/P effect in the marginal portfolios.

The results for the All-firm Sample showed very similar trends as for the Calendar-year Sample, particularly for the 1977 test period. The most notable difference was that a much larger proportion of mean abnormal returns were significantly different from zero for the All-firm Sample. For example, eight (17.8%) out of the total of 45 portfolio cells are significant at the 10% level or better,[4] and every significant mean abnormal return coincided with either a minimum or maximum value. In addition, all minimum-maximum pairs within the individual portfolio cells are significantly different at the 5% level or better,[5] and the E/P marginal pair for 1977 is significantly different at the 5% level. In general, the results of the All-firm Sample tend to track those for the Calendar-year Sample, except that the results for the All-firm Sample were at a higher, and, therefore, more respectable level of significance than for the Calendar-year Sample.

The reason why there is a relatively higher proportion of significant mean abnormal returns for the All-firm Sample is probably due to two factors. First, since the All-firm Sample is 50% larger than the Calendar-year Sample, it is a more representative sample and has a greater tendency to capture any firm-specific effects as reflected by significant abnormal returns. And second, the eight-fold increase over the Calendar-year Sample in the number of mean abnormal returns which are significantly different from zero is probably a manifestation of the bias mentioned in the Methodology; that is, an E/P ratio representing a fiscal year which extends itself into the test period tends to bias this firm-specific variable since it is based on more information than the market would have and thus strengthens the estimated abnormal return.[6] For this reason the All-firm Sample was hereafter eliminated and only the Calendar-year Sample used for the other two matrices.

Analysis of Variance

This statistically powerful and robust test provides an overall view and simultaneously investigates the differences between the means of the abnormal returns from the two populations as related to changes in D/P and E/P ratios. Since it is recognized that the underlying assumptions of the ANOVA model may not be met,[7] this test will be used for

guidance only and the results will later be evaluated in light of the other tests as shown in Table IV.

Table II, panel (a) on the left indicates only one significant result for the Calendar-year Sample: a significant difference between the three levels of E/P ratios associated with the means of the abnormal returns for the 1977 test period. In other words, one cannot state that the means of the abnormal returns are all the same on the basis of differences in the E/P ratios. The insignificant interaction F statistic indicates that:

1. the results for a particular level of D/P ratio does not depend on the E/P ratio, or
2. the results for a particular level of E/P ratio does not depend on the D/P ratio, or
3. the results do not depend upon both the level of D/P and E/P ratios.

The results for the All-firm Sample have been included to confirm the results of the individual and marginal portfolio tests, which show relatively higher levels of significance as compared to those for the Calendar-year Sample except for the 1977 test period.

Friedman's Test

Table II panel (a) on the right shows the results of the non-parametric equivalent of two-way ANOVA. This test

Table II

Two-Way ANOVA and Friedman's Test*

(a)

Test Period	Sample	Two-Way ANOVA D/P	Two-Way ANOVA E/P	Two-Way ANOVA Inter-action	Friedman's Test Rank by D/P	Friedman's Test Rank by E/P
1969	Calendar-year	0.358	0.060	-	0.667	0.667
	All-firm	0.764	0.456	-	0.667	2.000
1973	Calendar-year	0.303	0.108	-	0.667	0.0
	All-firm	0.922	0.350	-	2.000	2.000
1977	Calendar-year	4.099	19.416^z	-	4.667^x	4.667^x
	All-firm	1.880	10.852^y	-	4.667^x	4.667^x
1969 1973	Calendar-year	1.071	1.626	0.355	-	-
1977	All-firm	4.389^y	6.884^z	2.680^x	-	-

(b)

Test Period	Sample	Two-Way ANOVA E/P	Two-Way ANOVA F.S.	Two-Way ANOVA Inter-action	Friedman's Test Rank by E/P	Friedman's Test Rank by F.S.
1969	Calendar-year	0.567 [4.609^x]	0.302 [1.250]	-	0.667 [4.667^x]	0.667 [2.000]
1973		0.106 [0.067]	0.190 [0.232]	-	0.667 [0.667]	0.667 [2.667]
1977		6.577^y [13.021^y]	1.396 [9.993^y]	-	4.667^x [6.000^y]	0.667 [4.667^x]
1969 1973 1977		2.856^x [2.768^x]	1.025 [$2.553^{11\%}$]	1.642 [0.666]	-	-

[ ] = Reranked Matrix 2 re: Table V of thesis.

(c)

Test Period	Sample	Two-Way ANOVA F.S.	Two-Way ANOVA D/P	Two-Way ANOVA Inter-action	Friedman's Test Rank by F.S.	Friedman's Test Rank by D/P
1969	Calendar-year	0.075	1.660	-	0.667	2.667
1973		0.047	0.793	-	0.667	2.667
1977		2.105	1.399	-	2.000	2.000
1969 1973 1977		1.229	2.662^x	1.695	-	-

*Superscripts x, y, and z denote levels of significance of 10%, 5%, and 1%, respectively.

tends to support the parametric tests for the 1977 test period; although both chi-square statistics are significant at the 10% level, the F statistic for the D/P effect was significant at about the 12% level for the ANOVA test.

Summary Results

Table IV summarizes the foregoing results of the various tests, and attempts an initial interpretation for each matrix. In arriving at the "final summary" for the matrix as a whole, a series of priorities were established as follows:

1. Only results which wre significant at the 10% level or better can contribute directly towards a firm conclusion.
2. The most statistically powerful and meaningful tests appear to be in order of priority: ANOVA (triple replicated), ANOVA (single test period), and the non-parametric Friedman's Test. Relatively less weight was placed on the pattern of the minimum-maximum mean abnormal returns in the individual and marginal portfolio cells. These tests indicate secondary effects and are more subject to "noise" associated with inadequacies in the size and quality of the data base. In all cases, the marginal portfolio tests confirmed the single test period ANOVA results, whereas the individual portfolio tests were much less consistent.

3. Individual tests which were insignificant can, however, be used as weak supportive evidence, particularly in instances where the test statistics are close to the 10% level of significance.

Using the above set of priorities, the various summaries in panel (a) for each test for the matrix under study point to a fairly consistent conclusion. The E/P ratio for the 1977 test period is the strongest contributing factor in explaining the significant abnormal returns in this test period. The triple replicated ANOVA test, however, shows insignificant results for all three test periods taken together.

The Effect of Firm Size

Using the market value of the firm as a surrogate for firm size, the mean and variance of the value of the firm were calculated for each portfolio cell for both samples. These data replaced the means and variances of the mean abnormal returns for each individual and marginal portfolio cell, and were subjected to the same set of tests. One would expect an inverse relationship between firm size and E/P ratio,[8] and perhaps a similar inverse relationship between firm size and D/P ratio since the D/P and E/P ratios are positively correlated to one another.[9]

A brief scan of the now familiar tests in Table III confirms the hypothesized results.[10] Panel (a) shows a definite trend for the minimum and maximum firm size portfolios to be segregated in the hypothesized cells.[11] The marginal porfolio cells show a stronger trend for firm size to be segregated according to changes in E/P ratio than to changes in D/P ratio.[12] This conclusion is confirmed by the average mean firm size values[13] across all three test periods taken together as shown by the ANOVA results, and, to a certain extent, the Friedman's Test results in panel (b). In this case it can be stated that there exists a stronger tendency for significant differences to exist between the three levels of E/P ratios associated with firm size means than between the three levels of D/P ratios.[14] The strong interaction effect indicates a significant amount of proxying of one ratio for another, thus indicating the desirability of separating the three firm specific variables - D/P ratio, E/P ratio, and firm size - and examining them in various dual combinations.

The next matrix is set up such that the securities are classified first on the basis of low, medium, and high E/P ratio, and, secondly, according to large, medium, and small firm size.

TABLE III Special Test Showing Firm Size ($x10^{-6}$) in lieu of Mean Abnormal Returns for Matrix One*

(a)

D/P → / E/P ↓	LOW 1969	LOW 1973	LOW 1977	MEDIUM 1969	MEDIUM 1973	MEDIUM 1977	HIGH 1969	HIGH 1973	HIGH 1977	MARGINAL 1969	MARGINAL 1973	MARGINAL 1977
LOW	-	546.0 Max.	-	359.7 Max.	-	-	- -	- -	-	295.2 Max.	418.7 Max.	
MED	-	-	777.1 Max.	-	-	-	-	-	-	-	-	440.4 Max.
HIGH	-	-	-	-	-	42.8 Min.	85.3 Min.	59.4 Min.	-	153.7 Min.	78.0 Min.	74.9 Min.
MARGINAL	170.0 Min.	374.3 Max.	362.6 Max.	295.2 Max.	-	161.2 Min.	-	188.3 Min.	-			

(b)

Test Period	Sample	Two-Way ANOVA D/P	Two-Way ANOVA E/P	Two-Way ANOVA Inter-action	Friedman's Test Rank by D/P	Friedman's Test Rank by E/P
1969	Calendar-year	3.271	3.827	-	4.667^{x}	2.667
	All-firm	3.206	4.932^{x}	-	2.667	2.667
1973	Calendar-year	4.575^{x}	15.236^{y}	-	6.000^{y}	6.000^{y}
	All-firm	0.633	3.515	-	2.667	4.667^{x}
1977	Calendar-year	1.496	4.204	-	4.667^{x}	6.000^{y}
	All-firm	0.868	2.701	-	0.667	6.000^{y}
1969 1973	Calendar-year	513^{z}	$2,191^{z}$	$1,703^{z}$	-	-
1977	All-firm	1.761	9.743^{z}	6.327^{z}	-	-

*Superscripts x, y, and z denote levels of significance of 10%, 5%, and 1%, respectively.

E/P - Firm Size Matrix Two

Introduction

Since the reader is now familiar with the various tests and in order to avoid repeating the full analytical details of each test for the second and third matrices, a condensed approach is adopted.

Analysis

Table I, panel (b) indicates that five (11.1%) out of the total of 45 portfolio cells are significant at the 10% level or better,[15] and the minimum and maximum values are generally in the hypothesized direction[16] except for the E/P marginal portfolio cells in the 1973 test period. Again, the 1977 test period shows the strongest segregation, particularly according to the E/P ratio as indicated by the significantly different E/P marginal portfolio cells,[17] which is supported by a similar statistically significant segregation pattern for the individual portfolio cells.

Table II, panel (b) confirms the previous results: there is a significant difference between the three levels of E/P ratios associated with the means of the abnormal returns for all three test periods taken together, and particularly for the 1977 test period as indicated by

significant statistics for both the parametric and non-parametric tests. Again, the insignificant interaction statistic indicates a degree of independence between these two firm-specific variables in determining the magnitude of the mean abnormal returns.

Looking at the results overall and attempting an initial interpretation, Table IV, panel (b) again shows the E/P effect predominating for the 1977 test period, as well as for all three test periods according to the triple replicated ANOVA test. There is weak evidence that both effects may be equally strong during the 1969 test period.

Firm Size - D/P Matrix Three

Table I, panel (c) again indicates five (11.1%) out of the total of 45 portfolio cells are significant at the 10% level or better.[18] Whereas the pattern of the minimum and maximum mean abnormal returns in the individual portfolio cells indicates a stronger segregation according to D/P ratio for the 1973 test period,[19] the corresponding marginal portfolio cells provide no indication of one firm-specific variable having a stronger effect than the other.[20]

The ANOVA test indicates the existance of a significant difference between the three levels of D/P ratios associated with the means of the abnormal returns for all three test periods taken together. The insignificant interaction

Table IV. Summary of Regular Statistical Tests*

(a)

Minimum-Maximum Mean Abnormal Returns: Indiv. Portfolios			Marginal Portfolios: D/P			Marginal Portfolios: E/P			ANOVA			ANOVA: Replicated		Friedman's Test			Overall Summary			
'69	'73	'77	'69	'73	'77	'69	'73	'77	'69	'73	'77	'69 '73 '77	I/A	'69	'73	'77	'69	'73	'77	'69 '73 '77
N/S	N/S	D/P Z	N/S	N/S	N/S	N/S	N/S	X	N/S	N/S	E/P Z	N/S	N/S	N/S	N/S	Both X	N/S	N/S	E/P	N/S

(b)

Minimum-Maximum Mean Abnormal Returns: Indiv. Portfolios			Marginal Portfolios: E/P			Marginal Portfolios: Firm Size			ANOVA			ANOVA: Replicated		Friedman's Test			Overall Summary			
'69	'73	'77	'69	'73	'77	'69	'73	'77	'69	'73	'77	'69 '73 '77	I/A	'69	'73	'77	'69	'73	'77	'69 '73 '77
Both X	N/S	E/P Z	N/S	N/S	Y	N/S	N/S	N/S	N/S	N/S	E/P Y	E/P X	N/S	N/S	N/S	E/P X	Both ?	N/S	E/P	E/P

(c)

Minimum-Maximum Mean Abnormal Returns: Indiv. Portfolios			Marginal Portfolios: Firm Size			Marginal Portfolios: D/P			ANOVA			ANOVA: Replicated		Friedman's Test			Overall Summary			
'69	'73	'77	'69	'73	'77	'69	'73	'77	'69	'73	'77	'69 '73 '77	I/A	'69	'73	'77	'69	'73	'77	'69 '73 '77
N/S	D/P Y	Both Y	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	D/P X	N/S	N/S	N/S	N/S	N/S	D/P ?	Both ?	D/P

*X, Y, and Z denote levels of significance of 10%, 5% and 1%, respectively. N/S denotes not significant.
Data from Tables I and II.

statistic confirms a continuing degree of independence between the effect of the firm-specific variables in contributing towards abnormal returns.

When all the results are laid out and compared in panel (c) of Table IV, the contradictory nature of the results becomes more apparent. Overall, there is a reasonably strong trend for the D/P effect to dominate firm size for all three test periods taken as a whole. When the test periods are studied separately, however, there is weak evidence that both effects may be contributing towards the statistically significant mean abnormal returns which predominate in the 1977 test period.[21] The D/P effect may predominate during the 1973 period, which could be the influencing factor for the triple replicated ANOVA favouring the D/P effect when all three test periods are taken as a whole.

Factors Possibly Affecting the Interpretations

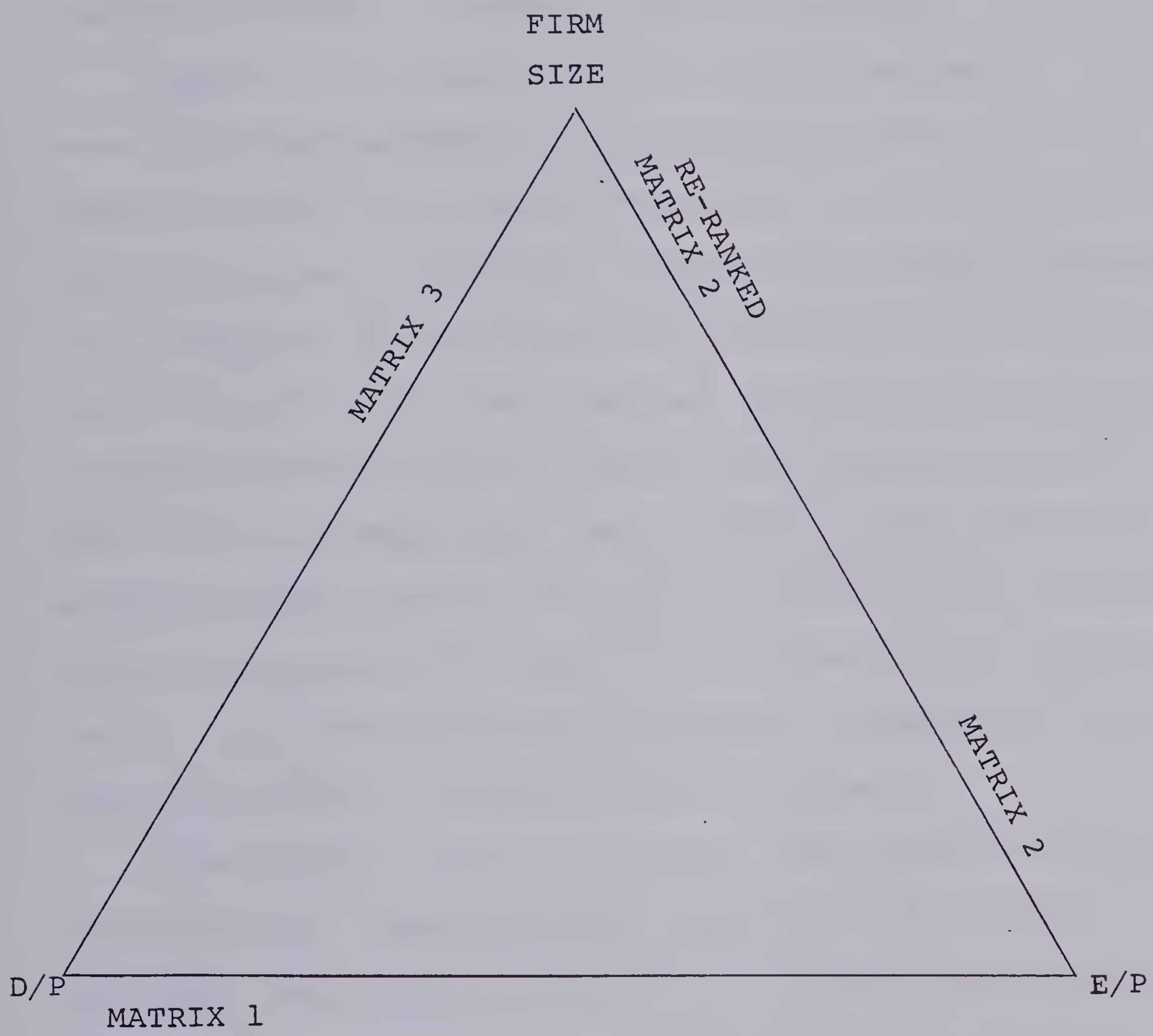
Introduction

The preceding summary results are tentative, since, prior to arriving at any final conclusions, there are a *potpourri* of concerns, gleaned in part from the literature, which should be addressed. These factors relate to inherent weaknesses in the data base and methodology.

Order of Ranking Securities

Although it has been stated previously in Chapter IV that according to the literature the results should not be significantly affected by the order in which the securities are ranked, a check was done for the second matrix which estimated abnormal returns in terms of the E/P ratio and firm size. As indicated in Figure 2, the securities were ranked first according to E/P ratio and secondly by firm size. Blume (1980) hypothesized that by ranking his portfolios first according to betas and second according to dividend yields, he would obtain less variability in dividend yields than if he had ranked on dividend yields first, and, as a result, bias his results against finding a dividend effect - the objective of his research. On reranking, he discovered that the percentage increase in his regression coefficients and t values were twice as large for that variable used to rank the portfolios first, as compared to those for the variable now relegated to a second position.[22] Although these changes did not materially affect his results, they did confirm his initial suspicion. The results of the initial E/P - firm size ranking in this thesis favoured the E/P variable for at least the 1977 test period, and for all three test periods taken together. Perhaps if the securities were ranked first

FIGURE 2: Order of Ranking Securities in the Various Matrices



according to firm size and second according to E/P ratio, relatively greater variability may be obtained in firm size which may increase the relative influence of this firm-specific variable in causing abnormal returns.

Table V is a summary of this second ranking.[23] It does show firm size manifesting a stronger influence but not enough to materially affect the overall results, which is in line with Blume's findings. The most significant result of this reranking is the significant firm size effect during the 1977 test period, and the fact that the firm size effect is significant at the 11% level in the triple replicated test. On the other hand, the E/P effect has a relatively stronger effect during the 1969 test period and to a lesser extent during the 1977 test period in the second ranking. Overall, the E/P effect has a tendency to dominate firm size regardless of how the securities are ranked.

None of the other two matrices were reranked since it was felt that, considering the results of the initial rankings, the overall results would not be significantly affected. In the first matrix, for example, which was ranked first according to the D/P ratio and second according to the E/P ratio, the overall results tended to favour the E/P effect, particularly for the 1977 test period. Reranking the securities initially by E/P ratio would probably augment the relative strength of the E/P ratio. Similarly, the third matrix which was ranked first according

Table V. Summary of Statistical Tests for Reranked Matrix 2*

(b)

Minimum-Maximum Mean Abnormal Returns: Indiv. Portfolios			Marginal Portfolios: Firm Size			Marginal Portfolios: E/P			ANOVA			Replicated		Friedman's Test			Overall Summary			
'69	'73	'77	'69	'73	'77	'69	'73	'77	'69	'73	'77	'69 '73 '77	I/A	'69	'73	'77	'69	'73	'77	'69 '73 '77
N/S	E/P	E/P	N/S	N/S	N/S	N/S	N/S	N/S	E/P	N/S	F.S.	E/P	N/S	E/P	N/S	F.S.	E/P	N/S	Both	E/P
	Y	Z						11%	X		Y	X		X		X				
											E/P	F.S				E/P				
											Y	11%				Y				

*X, Y, and Z denote levels of significance of 10%, 5%, and 1%, respectively. N/S denotes not significant. Compare with Table IV, panel (b).

to firm size and second by D/P ratio showed a trend for the D/P effect to dominate, particularly for the important ANOVA triple-replicated test. Again, reranking would probably tend to strengthen the D/P effect and perhaps eliminate some of the contradictory results previously mentioned.

Bias in E/P Ratio

The writer became suspicious of the dominant influence of the E/P effect in both matrices in which the E/P ratio was included as one of the firm-specific variables. This suspicion was fueled by Reinganum's findings that "... an E/P effect does not emerge after returns are controlled for the firm size effect; the firm size effect largely subsumes the E/P effect."[24] Although the All-firm Sample was rejected early in the research for reasons already stated, the Calendar-year Sample may not be completely free of a similar type of bias. Watts (1978), whose methodology is similar to that of this thesis, takes the precaution of calculating his quarterly abnormal returns

> ... over varying intervals commencing the week <u>after</u> the calendar week in which the quarterly earnings are first announced in the <u>Wall Street Journal</u>. Thus, the abnormal returns ... do not incorporate the contemporaneous price adjustment to any information in the quarterly earnings and hence do not overstate the abnormal returns because of that price adjustment.[25]

Reinganum, in his research based on quarterly E/P ratios, also takes announcement dates into account by computing his

quarterly E/P ratios on both a pre- and post-earnings announcement price basis. His intention in ranking his E/P ratios on a post-announcement price basis was to ensure that his abnormal returns only reflect the equilibrium effect between E/P ratios and asset pricing, assuming, of course, that capital markets rapidly incorporate information into prices.[26] Morgan in his research on dividends and capital asset pricing also takes announcement dates into account by stating that unless this is done "Residuals [or abnormal returns] ... cannot be used in a test of market efficiency ...".[27] The writer, on the other hand, did not take announcement dates into account, since the denominator in the E/P ratio is the pre-announcement price, and the test period immediately follows the sample period.

The results of one of these three researchers, however, suggests that taking announcement dates into account makes little difference.[28] Reinganum discovered that

> "... by scaling ... [E/P ratios] ... by a post- rather than pre-earnings announcement price and re-ranking securities ... the magnitudes of the 'abnormal' returns across purchase dates ... are virtually identical ...".[29]

Interestingly, he concludes that "... the persistence of the 'abnormal' returns, ... seems to rule out a market inefficiency explanation,"[30] and attributes his abnormal returns to a misspecification of the CAPM. As a result of these initial findings, Reinganum did not bother to consider announcement dates in his subsequent research on annual E/P

ratios since "... the quarterly findings indicated that the E/P anomaly did not appear to be an information effect."[31]

The writer's conclusion is that security prices quickly adjust to published quarterly earnings reports and all other readily available interim information, such that for most securities, stock prices would have already adjusted to the previous annual earnings performance very early in the test period, if not before.[32] As a result, it appears that the concern of a bias in the E/P ratio as a result of not taking announcment dates into consideration may not be serious enough to affect the results in favour of a stronger E/P effect.

Weak Results for the 1969 and 1973 Test Periods

As noted in Tables IV and V, a review of the three "overall summaries" for panels (a), (b) and (c) indicate a general trend for significant results to be concentrated in the more recent test periods. Several plausible explanations for this trend are as follows:

1. Comparing the three sample-test period pairs, there were greater macroeconomic differences between the two earliest ones than between the most recent. Test period 1969 ushered in a recession, whereas test period 1973 was a boom year and part of a longer period characterized by an accelerating inflation rate which

peaked in 1974. During these turbulent years the validity of the E/P and D/P ratios as realistic estimates of the expected values during the following test periods might be questioned. By comparison, the 1976 - 1977 period was relatively more stable. The implication of these over-riding macroeconomic forces is that during the periods 1968 - 1969 and 1972 - 1973 the firm-specific variables under study would be changing rapidly and well within a one year period. In effect, this lack of stationarity would cause a relatively larger number of firms to be jumping from one portfolio cell to another. The result is that segregating the firms into their respective portfolio cells and relating the magnitude and direction of abnormal returns to a pair of firm-specific variables becomes increasingly more difficult; the over-riding macroeconomic forces have a "swamping" effect which dilutes the strength of the E/P and D/P effects.

2. As noted in Table VI, panel (a), the earnings per share (EPS) data were obtained from a variety of sources which are listed in order of priority used. Since EPS data were obtained for as many of the securities as possible from the first two sources prior to deciding on the priority ranking, it is possible to determine the order of magnitude of the discrepancies between the EPS data from these two sources as depicted in Table VI, panel

Table VI. Sources of Earnings per Share Data, and Discrepancies Between Earnings per Share Data From the Two Major Sources

(a)

Sample	Fiscal Year	Sources of EPS Data (%) Compu-stat-Can	F.P. Card	Personal Commun.	Annual Reports	CAN/ FIL	Stock Guides	No. Securities
All-firm	1968-69	59.7	27.7	6.3	4.5	1.4	0.4	221
	1972-73	58.8	29.0	6.3	4.1	1.4	0.4	221
	1976-77	58.4	31.6	5.9	3.6	0.9	-	221
Calendar -year	1968	63.9	25.9	6.1	2.0	1.4	0.7	147
	1972	61.9	27.6	5.9	2.6	1.3	0.7	152
	1976	62.1	28.8	5.2	2.6	1.3	-	153

(b)

Sample	Fiscal Year	Discrepancies Between Earnings per Share Data From the Two Major Sources (%) F.P. Card = Compustat-Can.	F.P. Card > Compustat-Can.	F.P. Card < Compustat-Can.	No. EPS Figures
All-firm	1968-69	65.6	21.9	12.5	160
	1972-73	84.0	9.2	6.8	162
	1976-77	88.3	6.8	4.9	162
Calendar -year	1968	70.6	19.6	9.8	92
	1972	79.1	13.2	7.7	91
	1976	88.1	5.4	6.5	92

(b). The writer has found evidence that some of the earlier EPS data from the F.P. Cards are on a restated basis, whereas this is definitely not so for the Compustat-Can EPS data. For example, there are several instances[33] where EPS data from the F.P. Cards were compared and found different from EPS data obtained from initial annual reports, past issues of Standard and Poor's Stock Guides, and personal correspondence with the firm's accounting department. The Compustat-Can reference manual states explicitly that its data has been obtained from "... the most timely, accurate, and informative sources of information available."[34] In addition, "The selected ... items that are available on a restated basis ..." are explicitly defined as being restated, and are obtained "... in five- and ten-year financial summaries ... as reported by the company."[35] Since no similar explicit definition of EPS exists in the F.P. Cards and considering the evidence obtained in the above comparisons, it appears likely that some EPS data from the latter source are on a restated basis as compared to the more precisely defined EPS data in the Compustat-Can data-base.

In addition, there is a tendency for the EPS figures to be higher in the Financial Post data-base whenever discrepancies exist. An explanation as to why EPS in the Compustat-Can file may differ from those in

company reports for Data Item No. 58 has been described in Appendix B. The implication here is that the Compustat-Can EPS figures will tend to be lower than those reported by the firm. Since the EPS figure is an

> ... indispensable measure of the increase in well being of common shareholders. ... [and] ... is used as a basis for predicting ... future market values of common shares. ... corporate managers often define their policy goals in terms of earnings per share of common stocks.[36]

Hence, the evidence indicates that the independently derived Compustat-Can EPS data are on a conservative "economic" basis, relative to the EPS data in the F.P. Cards which are on an "accounting" basis.

Perhaps the above differences between these two data bases explain why in the majority of cases the EPS figures for the F.P. Cards exceed those of the Compustat-Can file, and why these differences are more pronounced for the earlier test periods. This "dirtier" F.P. Card component of the E/P ratio file for the earlier test periods may have scrambled the rankings of the securities on the basis of the E/P ratio, and, as a result, weakened the E/P effect. In the first matrix the securities were ranked first according to the D/P ratio, since it was recognized at an early stage that the D/P ratio was a "cleaner" data base than the E/P ratio.

3. A third plausible explanation for the concentration of significant results to be within the more recent test periods could be rooted in a real but unknown phenomenon and not due to a weakness in the data base itself. Perhaps the E/P effect, for example, only shows up during the 1977 test period for some unknown legitimate reason, or perhaps the E/P ratio is acting as a surrogate for one or more unknown but true underlying variables, which might be associated with one or more microeconomic (the influence of a dominate industry, change in accounting procedures, etc.) or macroeconomic factors (change in tax laws, rate of inflation, investor behaviour, etc.).

Non-representative D/P Ratios

The percentage distribution of securities which declared from zero to a maximum of six dividends during the three sample periods for the Calendar-year Sample is listed in Table VII. In those instances where a particular security was reported in the Financial Post tape as having zero dividends during a sample period, the writer was reassured that in every case this was due to that security not having declared any dividends, rather than dividend information not being readily available.[37] In those instances where only one dividend was declared early in the

Table VII. Percent Distribution of Securities According To Number of Dividends Per Calendar Year.

Sample Period ↓	No. of Dividends per Calendar Year											No. Securities
	0	1					2	3	4	5	6	
		1st ¼	2nd ¼	3rd ¼	4th ¼	Total						
1968	7.5	1.4	2	0	5.4	8.8	11.6	5.4	66.0	0.7	0	147
1972	10.5	0	1.3	0	4.6	5.9	16.4	2.0	63.2	2.0	0	152
1976	5.2	1.3	1.3	0.7	3.3	6.6	17.6	3.3	60.8	5.2	1.3	153

sample period, there exists a possibility that it may not be a reliable estimate of the expected value for the succeeding test period year. Towards the end of the sample period an investor may have access to more timely information concerning the following year's expected dividend. Fortunately, the proportion of securities which declared only one dividend during a sample period is less than nine percent, and, as Table VII indicates, no less than 60 percent of these were during the latter half of the year.

Choice of Market Index

A question might arise as to what effect, if any, does the choice of market index have on the results? In Chapter II of this thesis, one of the hypotheses applicable to the CAPM was relaxed for testing the Market Model: namely, that the market proxy used is a valid measure of the true market portfolio which contains all risky assets in proportion to their relative value in the total marketplace.

Insofar as estimating beta coefficients is concerned, the majority of researchers used an equally-weighted market index,[38] and a few used both an equally-weighted and a value-weighted index.[39] Reinganum (1979-1981) conducted separate tests to determine if the choice of a market index (used to estimate betas, and as the "control portfolio" to calculate abnormal returns) actually affected the results.

He concluded that "Interpretations of the evidence are not altered ..." by whether an equally-weighted or value-weighted market index is used.[40] Even Banz, using a cross-sectional regression methodology, discovered that "... the choice of a proxy for the market portfolio does not seem to affect the results ... [since] ... there is little difference between the estimates."[41]

Inconsistent Results Within Test Periods

There are several inconsistencies in the results between different tests for a given test period within each matrix, which have already been explained and can be readily seen in Table IV. Admittedly, some tests are statistically more powerful than others, so that some inconsistencies are due to the weakness of the test itself or the input data failing to comply with some of the statistical assumptions inherent in the mathematical models used to derive the results.

It is also felt that the small sample size for each portfolio cell greatly increases the statistical variability of the results, as compared to similar tests conducted on U.S. data. For example, Reinganum (1981) used an average of 95 firms per portfolio,[42] and Basu used 100 securities per portfolio.[43] In the two studies whose methodologies are most similar to that of this thesis, Morgan (1979) uses a

large file consisting of "... common stocks on the NYSE from 1926 - 1977 and in the TSE from 1963 - 1977,"[44] while Watts (1978) used a much smaller sample consisting of 73 securities split into two portfolios: "... the firms with positive forecast errors ... and the firms with negative forecast errors."[45] The sixteen to seventeen securities per portfolio cell in this thesis is definitely a weakness in the methodology, which can be partially surmounted by concentrating on the macro scale and looking for consistent trends existing over two or more test periods within a particular matrix.

A Closer Look at the Overall Results

Statistically Significant Mean Abnormal Returns

Looking again at Table I on page 54 but this time at the overall results for all three test periods, one notices that there are few statistically significant mean abnormal returns. One reason for this is statistical; that is, the small sample size means relatively large standard errors for the mean abnormal returns, and, hence, lower t values. An explanation for the concentration of 72.7% of the significant values within the 1977 test period has already been proposed. Less obvious is an explanation as to why the total of eleven statistically significant abnormal returns

are concentrated towards the left and upper left part of the matrices, with the result that 72.7% of these are negative values. In Table VIII the writer has grouped the significant mean abnormal returns according to the various portfolio cells and levels of significance, irrespective of pairing arrangements and test periods. Observing the data from this new vantage point is not immune to criticism, but will serve as a point of reference for subsequent analysis.

The D/P effect falls generally into the hypothesized direction, except for the one negative contradictory value in the high category which can be reconciled on the basis of relative strengths. The one negative value is relatively weak, since it is significant at an 8% level of significance; its strength lies in the fact that it is from what is becoming evident as the most reliable 1977 test period. The one positive value is at a much higher level of significance and is a maximum value in that matrix; its weakness lies in the fact that it is from the 1973 test period. In conclusion, it would appear the weight of evidence is in favour of the latter positive value as being the most reliable, which is in conformity with the original alternative hypothesis.

The E/P effect also falls generally into the hypothesized direction, with the exception of the conflicting positive and negative values in the medium category. The one negative value at the 5% level is from

Table VIII. Number of Significant Mean Abnormal Returns Irrespective of Pairing Arrangement and Test Periods.*

Portfolio Cells		D/P			E/P			Firm Size		
	Level of Signif.	Low	Med.	High	Low	Med.	High	Large	Med.	Small
Individual	1%	-	-	-	1 (neg.)	-	-	1 (neg.)	-	-
	5%	2 (neg. min.)	-	1 (pos. max.)	1 (neg. min.)	1 (neg. min.)	-	2 (neg. min, pos. max.)	1 (neg. min.)	-
	10%	1 (neg.)	-	1 (neg.)	-	2 (pos.)	-	2 (pos,neg.)	2 (pos,neg.)	-
Marginal	1%	-	-	-	-	-	-	-	-	-
	5%	-	-	-	-	-	-	-	-	-
	10%	-	-	-	1 (neg.min. 1977)	-	-	1 (neg.min. 1977)	-	-

*Data from Table I.

the most reliable 1977 test period, whereas the two positive values are both at a lower level of significance and from the 1969 and 1973 test periods.[46] Hence, the weight of evidence is clearly in favour of the former negative value as being the most reliable. Nevertheless, a few positive mean abnormal returns in this E/P category do not violate the alternative hypothesis. Again, the hypothesized E/P effect stands up to rigorous analysis. The one negative mean abnormal return in the low marginal E/P category for the 1977 test period adds strength to this conclusion.

When the firm size effect is examined, however, a much more complex pattern emerges. One would expect in support of the alternative hypothesis that negative values would lie within the "large" category and positive values in the "small" category. The two anomalously positioned positive values in the high category from the 1973 test period is opposite to what one would expect; that is, Banz (1981) and Reinganum (1981) discovered that it is the smaller firms that contribute to abnormal returns. As Table I indicates, the positive maximum value at the 3% level of significance is from the third matrix where the securities were ranked first according to firm size, whereas the positive value at the 9% level of significance is from the second matrix where the securities were ranked secondly according to firm size. It appears that this anomalous firm size effect is independent of whether it is paired with the E/P or D/P

ratio, but is stronger when the securities are ranked first according to firm size. Is there possibly a subset of securities within the 1973 test period which is causing significantly large and positive mean abnormal returns and which is characterized at least in part by being relatively large firms? The mean firm size value in the large category during the 1972 sample period is 706.427×10^6 compared to 564.601×10^6 for the 1968 sample period and 607.569×10^6 for the 1976 sample period. A check was made to determine which securities in both of these portfolios for the 1972 sample period were also in the large category in the 1968 and 1976 sample periods. Both portfolios showed similar results; from 76.5% to 82.4% of the securities in the large category for the 1972 sample period were also in the large category in the other two sample periods, and those that were not were in the medium firm size category in the other two periods. These two positive mean abnormal returns in the large category represent a subset of relatively large firms either directly or indirectly associated with resource-based industries.[47] The explanation of this exception to the findings of Banz and Reinganum, then, could be due to facors related to a specific segment of industry, in this instance resource-based industries in metals, energy, and forest products.

The other significant firm size effects can be explained in a similar logic as was used to explain the E/P

effect. The one positive value in the medium category is at the lower level of significance and from the 1969 test period. The one negative mean abnormal return in the large marginal firm size category for the 1977 test period confirms Banz's and Reinganum's conclusions.

Before explaining the preponderance of significant negative mean abnormal returns and paucity of positive values, it is instructive to explain the influence of negative E/P and zero D/P ratios. In Appendix B it was hypothesized that the inclusion of "outlier" securities with negative E/P ratio in the data base may provide valuable information by producing large abnormal returns in the low E/P portfolios. Also, a preponderence of zero dividend paying securities within a low D/P portfolio may produce similar results. A review of those rows and columns with negative E/P ratios and/or zero D/P ratios in relation to those portfolios with significant negative abnormal returns, indicates exactly the opposite results as hypothesized. In Table I, panel (a), for example, the only significant negative mean abnormal return in the low D/P column for the 1977 test period was from the low D/P - medium E/P portfolio which has one zero D/P ratio. By comparison, the low D/P - high E/P portfolio has two zero D/P ratios, and the low D/P - low E/P portfolio has five zero D/P ratios and six negative E/P ratios (affecting a total of 8 or 47.1% of the securities in this portfolio),[48] but a t statistic of only

1.435 which is significant at the 20% level. A key to understanding this apparent contradiction is the fact that these outlier negative E/P and zero D/P securities comprise a minority proportion in these portfolios. The postulated individually low weekly returns of these "outlier" securities bias the mean weekly returns of the intermediate portfolios, which in turn bias the weekly rates of return for the market portfolios, and, finally, the estimated weekly abnormal returns. This bias is postulated on the basis of an observed relatively high variance of the mean of the 52 weekly abnormal returns in those portfolios with the highest proportion of negative E/P and zero D/P securities. Although the low D/P - low E/P portfolio had the second lowest mean abnormal return in the 1977 test period,[49] the effect of the eight securities having the zero D/P and/or negative E/P ratios was to produce a relatively large variance of 0.1309×10^{-3}, compared with an average variance of 0.0902×10^{-3} for the nine individual portfolios in this matrix[50] and a variance of 0.0778×10^{-3} for the significant mean abnormal return in the low D/P - medium E/P portfolio with a slightly lower mean value. The effect of this larger variance is, of course, to lower the t value. The hypothesis proposed in Appendix B is still correct; the outlier securities described previously would produce large abnormal returns if calculated <u>individually</u>. Including them in portfolios, however, produces a loss of statistical

power, particularly since they represent a minority proportion.[51] The above scenario repeats itself in the essentials in panels (b) and (c) in explaining the loss of statistical power by grouping the securities with negative E/P ratio and zero D/P ratios into portfolios.

Although the above explanation infers that securities with negative E/P and zero D/P ratios do not appear to fully explain the preponderence of significant mean abnormal returns, it must be noted that, of the total of six such values within the individual portfolios, four have from one to two negative E/P or zero D/P ratios. Hence, it can be inferred that these outliers contribute at least in part to explaining this phenomenum. Another contributing factor could be the number of zero returns; some securities may have had an unusually large number of zero returns due to zero trades during the week, no change in price from week to week, or missing data.

It is believed that similar arguments can be used to explain the lack of significant positive mean abnormal returns. Table IX shows the relationship between the statistical parameters of the minimum and maximum mean abnormal returns as presented in Table I. It is noted that in the majority of instances the positive (maximum) values are larger than the negative (minimum) values in terms of absolute values. In panels (a) and (b) it is noted that there are three maximum values which come close to being

Table IX. Mean and Variance of Minimum and Maximum Mean Abnormal Returns.*

(a)

Test Period	Absolute Value of Mean ($x10^3$)			Variance ($x10^3$)		
	Min.	Max.	% Diff.	Min. Mean	Max. Mean	$\bar{x}$
1969	1.00	$2.24^{12\%}$	124	0.1449	0.0989	0.1138
1973	0.98	2.05	109	0.1055	0.1730	0.1229
1977	2.94^{y}	$2.40^{12\%}$	-23	0.0778	0.1120	0.0902
$\bar{x}$	1.64	2.23	36.0			

(b)

1969	1.47	$3.64^{11\%}$	148	0.1633	0.2513	0.1243
1973	1.24	2.49	75	0.1719	0.1343	0.1119
1977	4.56^{y}	2.30	-54	0.1676	0.1188	0.1137
$\bar{x}$	2.42	2.81	16.1			

(c)

1969	0.89	1.87	110	0.1900	0.0897	0.1463
1973	1.54	3.18^{y}	68	0.1547	0.0960	0.1748
1977	2.88^{y}	1.60	-80	0.0809	0.1255	0.0966
$\bar{x}$	1.77	2.22	25.4			

$\bar{\bar{x}}$	1.94	2.42	24.7
	10.6%/yr	13.4%/yr	

*Data from individual portfolios in Table I. Superscripts denote level of significance.

significant at the 10% level and generally in the hypothesized direction. In panel (a) the corresponding variances are reasonably low, but the mean values are not quite large enough; increasing the mean values by less than 5% would make these maximum positive values significant at the 10% level. In panel (b) the maximum mean value for the 1969 test period has the largest positive value, but also the fifth largest variance for all three matrices. On the right side of each panel in Table IX it is seen that for 67% of the nine matrices the variances of the maximum values exceed the average of the nine individual portfolios within their respective matrices. It appears, then, that perhaps the major reason there are not more positive mean abnormal returns is due to the generally large variances of the mean abnormal returns at this end of the spectrum. By comparison, the mean variance of the six significant negative mean values (excluding the two marginal values) is 0.0877×10^{-3}. The paucity of significant positive values as measured by adhering mechanically to the 10% cutoff level of significance without the foregoing analysis can be very misleading when arriving at final conclusions.

Magnitude of the Mean Abnormal Returns

Looking at the absolute values of the minimum and maximum mean abnormal returns (regardless of level of

significance) over all three test periods on the left side of each panel in Table IX, a common pattern emerges regardless of the manner in which the securities are grouped. The percentage differences between the minimum and maximum values (relative to the minimum values) are remarkably consistent for each test period. Looking at Table I again, it is noted that in panels (b) and (c) the minimum and maximum values tend to line up according to the low and high E/P and D/P raios, respectively, whereas in panel (a) 83.3% are grouped according to the low D/P and/or low E/P categories. This observation supports the overall results in Table IV, which indicates that the D/P and E/P effects are stronger than the firm size effect. Hence, it appears that the D/P and/or E/P effects produce not only abnormal returns in the hypothesized direction, but also abnormal returns of relatively similar magnitude regardless of the test period. Test period 1969 enjoyed relatively large, and, in two instances, weakly significant positive mean abnormal returns. Test period 1977, on the other hand, experienced strongly significant negative values relative to generally insignificant positive values. There exists a consistent overall trend for the positive values to exceed the negative values.

Cumulative Results

Cumulative abnormal returns

Weekly Cumulative Abnormal Returns (CAR) were calculated for each individual portfolio. The following is an extension of the methodology in Chapter IV which uses the portfolio in the upper left cell of the matrix for the 1969 test period as an example:

$$CAR_T = \sum_{t=1}^{T} AR_t,$$

$$t = 69/1,\ 69/2,\ \ldots,\ 69/52$$

The array of 52 CAR values were plotted separately for both the All-firm Sample and the Calendar-year Sample in the D/P - E/P matrix (not shown). In the majority of portfolios the trends in the Calendar-year Sample tract those in the All-firm Sample, and the former trends are characterized by a more erratic distribution. The most notable exceptions in agreement between these two samples are in those matching portfolios which have the maximum number of securities not common to both samples.[52]

Looking just at the Calendar-year Sample, most CAR's take a fairly regular path from week 1 to week 52. According to the null hypothesis, the CAR values should obey a random walk with a zero mean, and, therefore, wander about zero. If there is a one-time effect on prices, the CAR

should adjust to the new level and then wander about that level.[53] In general, this is certainly not the case for the D/P - E/P matrix. An initial objective was to look for portfolios which exhibit one or more abnormal returns within the test period but which is compensated for later when the market adjusts, and, hence, yield insignificant abnormal returns for the test period as a whole. Both negative and positive "washed out" abnormal returns were detected in this matrix, particularly during the 1973 test period. The adjustments within the test period could be caused by several factors, including the overriding influence of a subgroup of securities within a particular portfolio adjusting to the combined effect of an increase or decrease in earnings and/or dividend announcements relative to the performance of the market as a whole. Information in the form of higher D/P and/or E/P ratios announced during the test period should produce positive adjustments, and the opposite, negative adjustments. This new information unique to a security or subgroup of securities would be reflected in the error term of the Market Model.[54]

Cumulative average abnormal returns

Since local "blips" may also represent noise from a small and imperfect data base, more weight should be placed on consistent trends across all three test periods.[55]

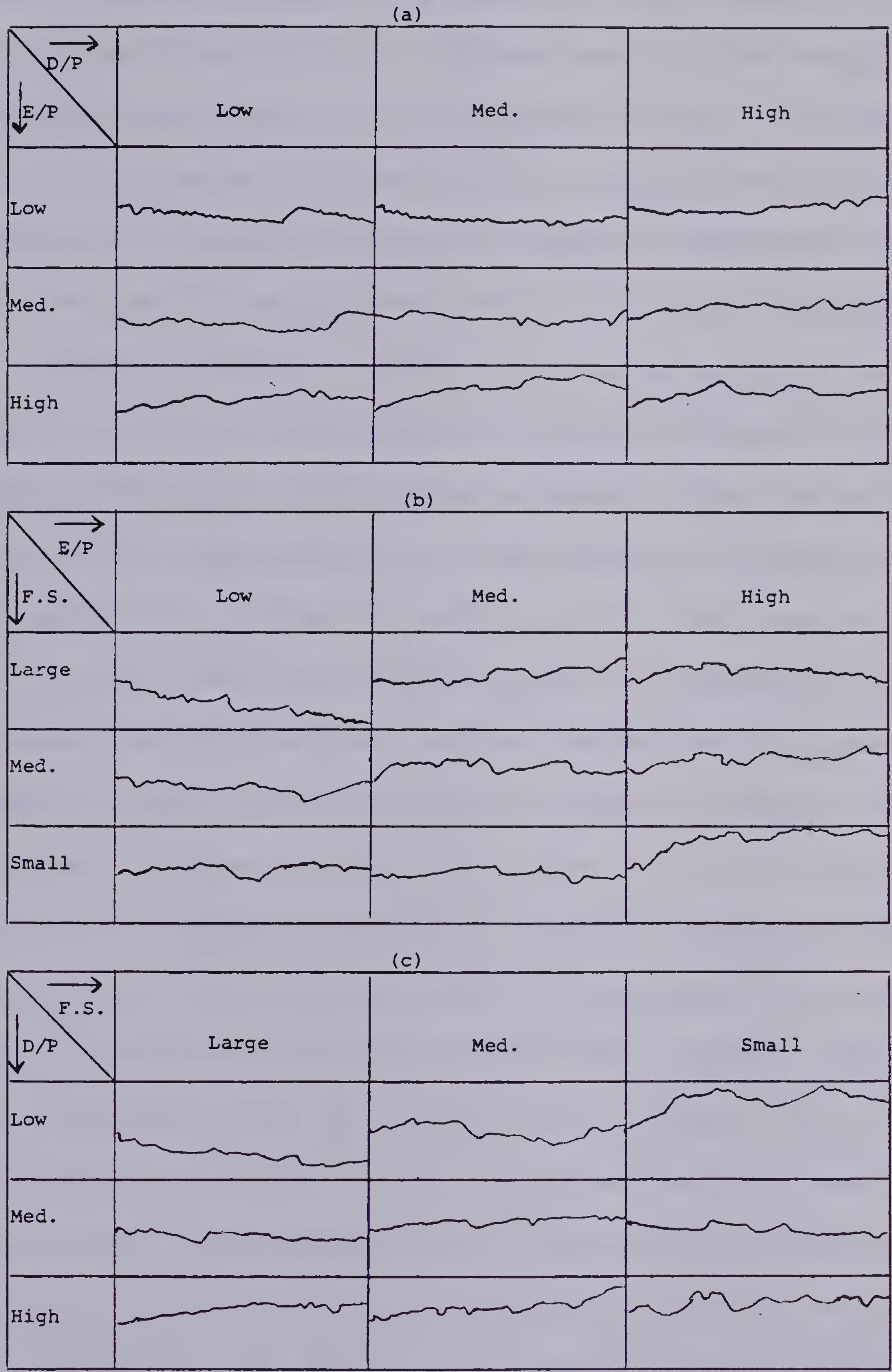
Therefore, the CAR's were aggregated over the three test periods into cumulative average abnormal returns (CAAR) as follows:

$$CAAR_T = \frac{1}{3}\,[CAR_{T,69} + CAR_{T,73} + CAR_{T,77}]$$

This was repeated for each of the other individual portfolio cells in the three D/P - E/P, E/P - F.S., and F.S. - D/P matrices, and the arrays of 52 CAAR values were plotted as shown in Figure 3. It was hoped that aggregating the data would eliminate much of the fluctuations attributable to noise. The CAAR plots in Figure 3, panel (a) display much less fluctuation than the CAR plots for the first matrix (not shown).

Although initially it was expected to identify abnormal returns within particular portfolios, there are statistical problems in attempting to interpret visually the apparent variability of the CAAR values within each portfolio. This time series obeys the statistics of a random walk, such that the variability at week 52 is 52 times that at week 1 assuming stationarity in the variance of the abnormal returns over a test period. The diverging confidence limits for the CAAR values from week 1 to 52 means that one should expect an increase in the variability of the CAAR's towards the latter part of the year purely for statistical reasons. This means one can only be confident in

Figure 3. Cumulative Average Abnormal Returns



interpreting local variability within a particular portfolio within the early part of a test period. Hence, one is on safer ground to look for differences in CAAR variabilities between rather than within portfolio cells. Although we are mainly interested in identifying abnormal returns, an attempt will be made first to explain differences in the CAAR variabilities between some of the portfolio cells.

Looking first at panel (c), one general pattern in this matrix is for the variance of the CAAR values to increase across the matrix from large to small firm size within the low D/P row, culminating in the largest variance occuring in the small F.S. - low D/P portfolio.[56] The reason for this is that the low D/P portfolios have a combination of zero and positive D/P ratios, and any relative increase in the number of zero D/P ratios will probably increase the variance. Indeed, this is the case. For all three test periods the number of zero D/P ratios increases across the low D/P row from large to small firm size,[57] such that the smaller firm size portfolios have the largest proportion of zero dividend yielding securities. An even wider range in the pooled variances exists from the large to small firm size across the high D/P row,[58] for which no explanation can be offered other than the suggestion that one would expect the variability of returns for small firms to be generally larger than those for large firms.

Panel (b) in general appears to exhibit a similar degree of comparative variability as does panel (c). Looking first at the low E/P column, an analogous situation exists with negative E/P ratios as with zero D/P ratios in panel (c); that is, for all three test periods the number of negative E/P ratios increases down the low E/P column from high to low firm size.[59] Again, the smaller firm size portfolios have the largest proportion of securities with negative earnings. This appears to be, however, more of an interesting characteristic for small firms, since there is very little difference in the pooled variances down the low E/P column from large to small firm size.

At this stage of the analysis it is instructive to quote an extract from Reinganum (1981), whose interpretations of his CAAR values is relevant to the writer's analysis:

> If there is a one-time effect on prices, the CAAR should adjust to the new level and then vacillate about that level. But the graphs do not demonstrate ... [this] ... pattern. Instead, one sees ... The CAAR of the low E/P portfolios exhibit a persistent negative trend. ... The CAAR of the high E/P portfolios trend upward, but not as markedly as the CAAR of the low E/P portfolios drift down in this time period. The graphs clearly illustrate that the mean 'abnormal' returns of the E/P portfolio positions ... are not due to extraordinary large 'abnormal' returns earned during the first couple of days the portfolios are held. Rather, the evidence indicates that the model is consistently misspecified; on average 'abnormal' returns can be earned on a day-to-day basis.[60]

An example of a strong negative E/P portfolio is in the low E/P - large F.S. cell,[61] and of two moderately strong positive E/P portfolios, in the medium E/P - large F.S. and high E/P - medium F.S. cells in panel (b). These CAAR plots exhibit the persistent negative and positive trends referred to by Reinganum (1981) in support of his conclusion that the Market Model is consistently misspecified. One exception to this trend is the high E/P - small F.S. portfolio which displays a large positive abnormal return during the first quarter, followed by a gradual upward drift during the remainder of the period. All three test periods in this latter portfolio had strong positive mean abnormal returns.[62] The large initial positive abnormal returning the first quarter may represent the dominating influence of a sub-group of relatively small firms whose E/P ratios on average yielded positive earnings announcements during the first quarters of 1969, 1973, and 1977 relative to the remainder of those years.

Panel (a) has the combination of the "active" D/P and E/P firm-specific variables, as compared to the relatively stable firm size variable in the other two matrices. The CAAR values here display the least variability within the three matrices, particularly in the lower E/P portfolios. It is postulated that this may be due to the short-term effects from both variables being in-phase on average, and, hence, augmenting one another.[63] This correlation between

the E/P and D/P ratios and their similar effects on the mean abnormal returns can be seen by the consistent trend for successively higher terminal CAAR values from low to high ratios in almost any direction.

The Firm Size Effect Revisited

The writer was somewhat puzzled as to why the results of Matrix 2 did not support Reinganum's strong findings that the firm size effect overpowers the E/P effect. Although the overall empirical results of this thesis clearly favour a strong E/P effect followed by a weaker D/P effect, it would be incorrect to state that no firm size effect was found.

As has previously been mentioned, one clear indication of a significant firm size effect showed up in the 1977 test period when Matrix 2 was reranked. Even the triple replicated ANOVA test yielded a marginally significant firm size effect at the 11% level. There is a message here that the firm size effect cannot be entirely ignored. Looking again at the CAAR results in Figure 3, one notices in panel (c) that a trend exists across the low D/P row for the final CAAR values to increase in the hypothesized direction from large to small firm size.[64] Again, in panel (b) similar trends exist down the low and high E/P columns,[65] and the CAAR plots for Matrix 2 reranked (not shown) display almost

identical trends across the low and high E/P rows.[66] Hence, by essentially holding either the D/P or E/P ratio constant, one notices that the final CAAR values increase in the hypothesized direction from large to small firm size within the low D/P category and within the low and high E/P categories; the ranges between the minimum and maximum CAAR values are from 0.1335 to 0.2616 and average 0.1769. The other two D/P rows in Figure 3, panel (c) display essentially flat curves with no trends, whereas the CAAR plots in the medium E/P column in panel (b) trend opposite to that inferred by the alternative hypothesis. In this last of six (excluding Matrix 2 reranked) rows and columns from small to large firm size, it is of interest to note that the range between the minimum and maximum final CAAR values is 0.0912, which is considerably less than the previous ranges mentioned above. Although half of these CAAR rows and columns tend to support a firm size effect, it must be realized that the CAAR values in week 52 are subject to high variances, and, as a result, are most probably not significantly different from zero.

One way to overcome the problem of the high variances of the final CAAR values and conduct two sample hypothesis tests is to use the grand mean abnormal returns and pooled variances. A separate analysis of these data indicated that the minimum and maximum grand mean abnormal returns were all significantly different at the 5% level for the low D/P row

in panel (c) and for the low and high E/P columns in panel (b). Interestingly, the corresponding two sample hypothesis test for the medium E/P column in panel (b), which trended opposite to the hypothesized direction, was insignificant. Hence, the previous firm size effects postulated from the final CAAR values have been confirmed by the grand mean abnormal returns.

Looking again at Reinganum's research, his data base consisted of 3505 daily observations over the fifteen year period 1963 to 1977,[67] compared to that of the writer who used 52 weekly observations for each of the years 1969, 1973, and 1977. Reinganum, incidently, was able to reject at the 1% level his null hypothesis that his mean excess abnormal returns within his smallest firm size portfolios are equal to those in his largest firm size portfolios within each E/P classification.[68] Banz using monthly data over ten year subperiods from 1936 to 1975 discovered that his firm size effect was not stable over time; in fact, his mean firm size premium coefficients in his cross-sectional regressions were only significant at the 10% level during his first 10 year period. When he lengthened his subperiods into two 20 year test periods, the firm size coefficients for both subperiods were significant at the 5% level; over the entire 40 year period, the firm size coefficient was significant at the 1% level.[69]

The results of this thesis are now cast into a different light when compared against the results of Banz and Reinganum. Since a firm size effect using U.S. data only manifests itself over relatively long periods of time, it is hypothesized that this might also be the case for Canadian data and help explain the apparent discrepancy between Reinganum's and the writer's results. The firm size effect using Canadian data appears to strengthen overall after the data for the three one-year test periods are aggregated, thus tending to reconcile Reinganum's results with the relatively weak firm size effect in this thesis.

NOTES

1. Refer to thesis, pages 22 to 23.
2. At the 1% level of significance.
3. At the 10% level of significance.
4. Five at the 10% level, and three at the 5% level of significance.
5. Two at the 5% level, and one at the 1% level of significance.
6. Watts (1978: 134, footnote 4) sites an analogous situation "... of a study which is not predictive ..." and concludes that "... any significant abnormal returns ... could be due to [a] price adjustment." which occurs during the period represented by the abnormal returns.
7. Mulder (1981: 44-45).
8. Reinganum (1981: 41).

9. Simple linear regressions were run on the D/P ratio - E/P ratio pairs for the three sample periods as follows:

Sample Period	Regression Formula	Sample Size N	% out-liers omitted	R^2	$t_{b,n-2}$ (level of signifi-cance)
1968	E/P=0.01757 + 1.23446 D/P	146	0.7	0.23075	6.572 (0.1%)
1972	E/P=0.04805 + 0.78392 D/P	149	2.0	0.15842	5.260 (0.1%)
1976	E/P=0.09380 + 0.67647 D/P	149	2.6	0.04226	2.547 (2%)

The highly significant t statistics indicate that, from a statistical standpoint, the E/P and D/P ratios are strongly related. The relatively small coefficients of determination, however, indicate that from an economic point of view the relationship is much weaker, virtually disappearing in the 1976 sample period.

10. Only the Calendar-year Sample will be analyzed, unless otherwise stated.

11. Only the min-max. pair for the 1977 test period was significantly different from one another at the 1% level of significance.
12. For the E/P marginal portfolios the min.-max. pairs are significantly different for 1973 (5% level) and 1977 (1% level), as compared to the D/P marginal portfolios where the min.-max. pairs are significantly different for the 1969 (10% level) and 1977 (10% level) test periods.
13. These values have been reduced by a factor of 10^{-6} to make them manageable.
14. Simple linear regressions were run on the E/P ratio ($x10^3$) - firm sixe ($x10^{-6}$) and the D/P ratio ($x10^3$) - firm size ($x10^{-6}$) pairs for the three sample periods as follows:

Sample Period	Regression Formula	Sample Size N	% outliers omitted	R^2	$t_{b,n-2}$ (level of significance)
1968	E/P=151.032 − 0.60308 F.S.	130	11.6	0.02803	1.921 (10%)
1972	E/P=205.287 − 0.93610 F.S.	135	11.2	0.05584	2.804 (1%)
1976	E/P=177.873 − 0.32353 F.S.	140	8.5	0.03418	2.210 (5%)
1968	D/P=137.930 − 0.80002 F.S.	133	9.5	0.01146	1.232 (insig.)
1972	D/P=141.653 − 0.28044 F.S.	139	8.6	0.00137	0.434 (insig.)
1976	D/P=132.998 + 0.00251 F.S.	141	7.8	0	0.005 (insig.)

These regressions confirm the other tests, in that there exists a weak but marginally significant inverse relationship between the E/P ratio and firm size, but no relationship at all between the D/P ratio and firm size.

15. The three individual portfolio cells which are significantly different from zero but do not coincide with a min. or max. mean abnormal return are second only to the min. or max. values.
16. The min.-max. pairs for the individual portfolios in the 1969 and 1977 test periods are significantly different at the 10% and 1% levels, respectively.
17. At the 5% level; the only min.-max. pair of marginal portfolio cells which are significantly different from one another.
18. The two individual portfolio cells which are significantly different from zero but do not coincide with a min. or max. mean abnormal return in the 1977 test period are the two lowest mean values next to the min. value.
19. The min.-max. pairs are significantly different for the 1973 and 1977 test periods, both at the 5% level.
20. The minimum mean abnormal return in the firm size marginal portfolio cells for the 1977 test period is the only one of the marginal portfolio cells for all three test periods which is significantly different from zero.
21. Four of the five statistically significant mean abnormal returns occur within the 1977 test period.
22. Blume (1980: 570-571).
23. Refer to Table II, panel (b).

24. Reinganum (1981: 19).

25. Watts (1981: 134).

26. Reinganum (1981: 26).

27. Morgan (1979: 6).

28. Watts' results are not directly applicable to this thesis since the author used straigh earnings, and Morgan does not test his hypothesis that considering announcement dates is important.

29. Reinganum (1981: 32,27).

30. Ibid (1981: 34).

31. Ibid (1981: 35).

32. Tiniç and West (1979: chapter 18).

33. Security nos. 23, 132, 210, and 236 in the Financial Post (TSE) tape; the last two are in the All-firm Sample.

34. Industrial Compustat (1980: section 6, page 1).

35. Ibid (1980: section 6, page 4).

36. Lev (1974: 18).

37. Personal communication with Mr. A. Hsu and Dr. S. Tiniç, Department of Finance and Management Science, University of Alberta.

38. The only researchers who used only a value-weighted market index were Litzenberger and Ramaswamy (1979: 181).

39. Morgan (1979: 4), Banz (1981: 6), and Reinganum (1981: 29).

40. Reinganum (1981: footnotes 8 and 10).

41. Banz (1981: 8, 10).

42. Reinganum (1981: 36).

43. Basu (1977: 665, footnote 7).

44. Morgan (1979: 4).

45. Watts (1978: 130).

46. The value from the 1969 test period is at an interpolated 7% level of significance; that from the 1973 test period, at an 8% level.

47. Of the total of 25 different securities (9 were common to both) in these two portfolios, 56% were in resource-based industries (metals, energy, forest products), 12% in firms heavily associated with resource industries, and the remaining 32% equally divided between communications and surface transportation, financial and miscellaneous manufacturing. Thus, about 2/3 of the securities were in the cyclical resource-based industries.

48. Of which 3 or 17.6% have both negative E/P and zero D/P ratios.

49. Table I, panel (a) indicates that for the 1969 test period this portfolio had the minimum value in the matrix, and a total of 7 (41.2%) securities with negative E/P and/or zero D/P ratios of which 2 (11.8%) had both.

50. Refer to Table IX, panel (a).

51. Morgan (1979: 1-2) identifies an "... information loss due to aggregation" of stock returns into portfolios as being the major cause of the "... low statistical power ..." in Black and Scholes' (1974) methodology.

52. In the low D/P-medium E/P portfolios for the 1969 test period, 63% of the total securities are not common to both samples; and in the same portfolio for the 1973 test period, 71% are not common. These results were compiled separately but not reported in full.

53. Reinganum (1981: 30-31).

54. Tiniç and West (1979: 499).

55. The general methodology was explained in Chapter IV.

56. The pooled variances of the mean abnormal returns over the three test periods from large to small firm size across the low D/P row in Figure 3, panel (c) are 0.1294, 0.1989, and 0.2018 x 10^{-3}.

57. The number of zero D/P ratios in the low D/P ratio row from large to medium to small firm size for the three sample periods are as follows:

Sample Period	Firm Size Portfolio		
	Large	Medium	Small
1968	1	4	6
1972	2	4	9
1976	1	2	5

58. The pooled variances of the mean abnormal returns over the three test periods from large to small firm size across the high D/P row in Figure 3, panel (c) are 0.0780, 0.0989, and 0.2583×10^{-3}.

59. The number of negative E/P ratios in the low E/P ratio column from large to medium to small firm size for the three sample periods are as follows:

Sample Period	Firm Size Portfolio		
	Large	Medium	Small
1968	0	2	5
1972	0	1	6
1976	0	2	6

60. Reinganum (1981: 30-32).

61. The 1969 and 1973 test periods had the minimum mean values, and the 1977 test period, the penultimate mean value. The 1977 test period value was significant at the 1% level.

62. The 1969 test period had the maximum mean value (significant at the 11% level); the 1973 test period, the fourth highest; and the 1977 test period, the second highest mean abnormal return.

63. Refer to endnote 9.

64. The final CAAR values in Figure 3, panel (c) across the low D/P row are -0.0856, -0.0189, and 0.0880 (range 0.2616).

65. The final CAAR values in Figure 3, panel (b) down the low E/P column are -0.1105, -0.0223, and 0.0230 (range 0.1335), and down the high E/P column are -0.0030, 0.0582, and 0.1326 (range 0.1356).

66. The final CAAR values for Matrix 2 reranked across the low E/P row are -0.1039, 0.0123, and 0.0201, (range 0.1240), and across the high E/P row are 0.0051, 0.0584, and 0.1067 (range 0.1118).

67. Reinganum (1981: 42-44).

68. Ibid (1981: 42-43).

69. Banz (1981: 9, 16).

CHAPTER 6

CONCLUSIONS

The Market Model has been tested during three one-year periods using portfolios from a data base of about 150 TSE common stocks. The purpose of the study was to determine which, if any, of three firm-specific variables (E/P ratio, D/P ratio, and firm size) are not captured by the simple linear model. The methodology selected is both an adoption and extension of that used by Watts (1978) and Morgan (1979), both of whom worked primarily on U.S. data. As an extension of the above methodology, it is similar to that used by Reinganum (1981) since more than one firm-specific variable is examined at a time. Care was taken during the research to ensure that any abnormal returns found were real and not an artifact of the methodology; this separate analysis offered supportive evidence that the results are robust with respect to this and several variants of the methodology adopted.

On the basis of aggregating the data over the three one-year test periods (1969, 1973, and 1977), the results indicate that the null hypothesis, that the Market Model is complete, can be rejected at the 10% level of significance. Of the three firm-specific variables tested,

the E/P effect is by far the strongest, followed by a weaker D/P effect and a negligible firm size effect. Some positive abnormal returns are found in those portfolios of firms with the highest E/P and D/P ratios, and vice versa. But the E/P effect cannot be considered strong in an absolute sense, since it is inconsistent over time and only shows up during the 1977 test period. This leads me to suspect that perhaps the E/P ratio is acting as a proxy for one or more unknown underlying variables, and is more closely correlated to the true variable(s) than the other two firm-specific variables studied. The results of this research appears to support the growing body of evidence that the relationship between the expected return on a portfolio of common stocks and the E/P ratio and other firm-specific variables is by no means simple.

The persistent negative and positive trends in some of the aggregated CAAR plots indicate that average abnormal returns can be earned on a week-to-week basis, which support the conclusions of the majority of previous researchers that the Market Model is consistently misspecified rather than capital markets being informationally inefficient. This conclusion is strengthened by the fact that the firm-specific information used to test the Market Model in this thesis was obtained from publically available sources, and numerous studies show that capital markets are efficient at the semi-strong level. In supporting the alternative

hypothesis, it can be stated that the Market Model fails because the expected return on a portfolio of TSE securities is not only a function of systematic risk but also a function of such firm-specific variables as the firms' E/P ratios, and, to a lesser extent, their D/P ratios. Since the effect of these additional factors have become impounded in the error time of the Market Model, it is suggested that future research should consider including an E/P term as an independent variable into a Market Model analysis. Although this additional variable may not completely specify the model, the results of this and previous research indicate that such an expanded version of the Market Model would permit an investor to more completely specify the expected equilibrium rate of return for risky assets over short holding periods.

It is not the intent of this thesis to leave the reader with the impression that the Market Model is hopelessly inadequate. Actually, the inconsistent and relatively few significant abnormal returns obtained in this research indicate that the Market Model has held up fairly well in terms of the three firm-specific variables studied. It must be realized that the model was tested during three one-year periods spaced throughout a turbulent era during which the market was strongly influenced by macroeconomic and political forces. In addition, it was originally envisioned that the Market Model would apply only over long periods of time.[1] As Fama has so succinctly stated:

> The first purpose of a model is to improve [our] understanding of some real-world phenomenon. If the phenomenon is a complicated one, like the adjustment of stock prices to new information, then to abstract from unimportant and potentially confusing details and to focus on the important aspects of the problem, we must impose some simple structure on the world. Since the structure is simplified and is thus not a completely realistic view of the world, we call it a model.[2]

In essence, the writer has simply confirmed and refined our understanding of the unrealistic assumptions which have made the Market Model possible. Violating these assumptions is perfectly compatible with the real world and are bound to have an adverse effect on the performance of the model - particularly over short periods of time.

NOTES

1. Tiniç and West (1979: 321).

2. Fama (1976: 168).

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APPENDIX A

ADDITIONAL INFORMATION ON D/P RATIO

Calculation

The calculation of the annual D/P ratios for each firm within each of the three sample periods was accomplished using the Financial Post (TSE) tape. Since the dividends per share and price per share data for each security were listed separately, it was a relatively simple matter to calculate the D/P_{52} ratios with the aid of a short FORTRAN program. The only difference between the three sample periods was that in 1976 there were 53 weeks (i.e., 53 Fridays), so that the ratio for this most recent sample period was D/P_{53}. The FORTRAN program calculated the numerator of the D/P ratio as the sum of all dividends per share figures reported during the week of the ex-dividend date throughout the year, and then divided by the single price per share at the end of the last week of the sample period.

Distribution

Table X shows the distribution of D/P ratios within each sample period. It is to be noted that the greatest range within any sample period lies within the "high" category, followed by the "low" category.

Table X
Distribution of D/P Ratios

Sample Period	Low Min.	Low Max.	Medium Min.	Medium Max.	High Min.	High Max.	No. Securities
1968	0	0.02421	0.02431	0.03871	0.03875	0.07207	147
1972	0	0.02016	0.02062	0.03664	0.03672	0.12800	152
1976	0	0.03750	0.03774	0.06186	0.06222	0.58082	153

APPENDIX B

ADDITIONAL INFORMATION ON E/P RATIO

Sources

Computstat - Can File

This file identified as tape no. 6 in the BAC:BAC.DATA Retrieval System contains annual financial statements for 288 Canadian companies from 1960 to 1979, inclusive. The file contains a total of 60 historical data items reported in Canadian currency. All data items are reported on a fiscal year basis, except high, low and close prices and annual shares traded which are reported on a calendar year basis. The information used in this file comes from such sources as 10-K (annual) reports made public by the Securities and Exchange Commission, companies' annual reports, company contacts, Interactive Data Services Inc., National Association of Security Dealers Automated Quotations, Uniform Statistical Reports prepared by electric utility and gas companies, the Civil Aeronautics Board for some airlines companies, the Dow Jones News Service, the Wall Street Journal's "Digest of Earnings Reports", and several Standard and Poor's Publications including the Stock Guides.

The Compustat-Can Tape was considered to be the "cleanest" and most consistent source of economic earnings per share (EPS) for forecasting purposes. Unfortunately, this excellent source of EPS data covered only about 60% of the securities selected from the Financial Post (TSE) tape for the three sample periods as seen in Table VI on page 75. Nevertheless, with very few exceptions this source was used on a first priority basis.

Several data items were culled from this tape and entered onto 8 ½ " x 14" forms for each security, including Data Items no. 18 (income before extraordinary items and discontinued operations), No. 20 (available for common after adjustments for common stock equivalents), no. 22 (price-high), no. 23 (price-low), no. 25 (common shares outstanding), no. 26 (dividends per share), no. 53 (earnings per share (primary) - including extraordinary items and discontinued operations), no. 54 (common shares used to calculate primary earnings per share), no. 57 (earnings per share excluding extraordinary items and discontinued operations - fully diluted), and no. 58 (earnings per share (primary) - excluding extraordinary items and discontinued operations). It is Data Item no. 58 which correlates most closely with EPS data from other sources and with the definition of EPS data used by previous researchers. A detailed description of Data Item no. 58 is as follows:[1]

A. This item represents the primary earnings per share before extraordinary items and discontinued operations as reported by the company.

B. The primary earnings figures should be reported by the company (as outlined in Accounting Principles Board Opinion No. 15) after the effect of conversion of convertible preferred, convertible debentures, and options and warrants which have been identified as common stock equivalents and before extraordinary items.

C. This figure may differ from company reports in the following instances:

   1. Company reports include extraordinary items and/or discontinued operations.

   2. Company reports before the equity in earnings of non-consolidated subsidiaries.

D. The net and available for common are reduced by the current year's amount shown in the notes for Canadian companies not charging deferred income taxes to the accounts. This will produce a lower earnings per share than reported in the stockholder's report.

E. The earnings per share for Canadian companies will be based on the class of stock that is most widely held and traded in Canada. Calculations will be made in accordance with those provisions as described by the Canadian Institute of Chartered Accountants (CICA).

The Financial Post Coporation Service Pamphlets (F.P. Cards)

These 152 x 225 mm sized pamphlets (F.P. Cards) were the next most important source of EPS data, and, with few exceptions, was the second priority source for this data base. Files of these F.P. Cards in various states of completeness were located in Central Academic Building room 432 at the University of Alberta, the Edmonton Public Library, and at various investment firms in Edmonton. The only source reference to the information in the F.P. Cards is the statement, "This information is obtained from sources we believe to be reliable, but is not guaranteed" at the bottom of the last page on each pamphlet.

The information listed in the F.P. Cards is not entirely consistent nor correct. Although EPS figures are quoted in several ways, the "earnings per common share based on net income, operations" was used which correlates with Data Item no. 58 in the Compustat-Can tape. In some cases, however, the EPS figures are based on the weighted average number of shares outstanding during the year (usually month-end but also daily averages), but for the majority of securities are based on the number of shares outstanding at the end of the fiscal year. In three instances where EPS figures were quoted on both these bases, the latter basis gave the lowest EPS values as would normally be expected.

Whenever EPS figures were quoted in U.S. funds, they were converted to Canadian funds by dividing the U.S. EPS figures by the yearly average U.S. noon spot rates in terms of the Canadian dollar. In addition, 23 (10.8%) of the F.P. Cards (in terms of the All-firm Sample) were discovered to be deficient for one or more of the sample periods as follows: EPS data not being reported according to the required or acceptable definition (12), EPS data not being reported at all (5), suspected typographical errors in the reported data (4), and discrepancies existing in EPS data when compared to the initial annual reports as issued for the respective years (2).

Although F.P. Cards are available for 212 of the 221 securities in the All-firm Sample, less than one third of the securities for the three sample periods used EPS data from this source, since EPS data were obtained from the Compustat-Can tape whenever available. In six instances, however, the F.P. Card EPS figures were used instead of Compustat-Can figures where changes in the fiscal year-end within a sample period caused the latter source to report either zero EPS or different EPS figures when compared with those quoted in the F.P. Cards. The Compustat-Can manual states, "If a fiscal year change results in a company issuing an annual report covering less than nine months, ... all income statement items will be Not Available."[2] In the two instances[3] where the Compustat-Can file reported zero

(i.e., not available) EPS data, the F.P. Card reported an eight month fiscal period (as well as supplying the EPS data) which is in accordance with the above rule. In three other instances[4] where EPS data were discrepant between these two sources, the F.P. Card reported fiscal periods of eight, four, and five months, respectively. Since two of these three discrepancies were major and the Compustat-Can file does not report the length of these partial fiscal years, it was suspected that these three fiscal year periods as reported in the Compustat-Can file must have been equal to or greater than nine months in order to have been reported at all. It is suspected that these short periods between fiscal year changes may have been added onto the following twelve month fiscal year in the Compustat-Can file. Due to these uncertainties, it was decided to use the more explicitly identified data from the F.P. Card, rather than infer the length of these partial fiscal years from the Compustat-Can file. In one other instance[5] where a major discrepancy existed between these two data sources and the F.P. Card reported a partial fiscal year of nine months, the latter source was used due to the general uncertainty surrounding the length of these partial fiscal years as reported in the Compustat-Can file and the relatively high incidence of discrepancies in EPS data between these two sources for these inter-fiscal year periods. Finally, it is of interest to note that in three instances[6] where there

were no discrepancies between these two data sources, the F.P. Cards reported fiscal years of 14 months, 11 months, and nine months, respectively.

Personal Communication and Annual Reports

When research began in collecting EPS data, the writer had a number of concerns with regards to firm-specific variations in expressing EPS. As a result, a total of 99 letters were sent to 85 firms out of which 70 firms (82.4%) replied. Most replies of specifically requested EPS information were received by letter or phone. Although it was later discovered that some of the writer's concerns were not serious, a number of early annual reports were also received which provided EPS data from annual reports not available in the Edmonton Public Library, the University of Alberta libraries, and various investment firms in Edmonton.

Canadian Financial Information Library (CAN/FIL)

This is a comprehensive microfiche file of "... unabridged original documents that were filed with Canadian jurisdictions and stock exchanges ..." of Canadian companies for the period 1974 to 1977.[7] The microfiche are arranged by company name and stored on the second floor of the Edmonton Public Library.

In general, CAN/FIL is a mediocre source of EPS data, since the EPS figures were obtained from the historical summaries at the end of annual reports and, hence, some of these data may be on a restated basis. For three securities[8] EPS data were unable to be obtained from any other source, including personal correspondence. It was decided to "salvage" these three securities by using EPS from this source. The calibre of these data is probably on a level with that of the F.P. Cards.

Standard and Poor's Stock Guides

The writer was able to obtain several old editions of these 132 x 216 mm booklets which contain earnings per share and other basic stock data over at least a four year period. In two instances[9] it was necessary to use EPS data from two Standard and Poor's Stock Guides, since the EPS figure was not available from any other source.

Specific Concerns

Changes in Fiscal Year-ends

Table XI shows the distribution of all 221 securities whose fiscal years ended on the date indicated. The Calendar-year Sample for each sample period was a subset of

Table XI. Percent Distribution of Securities According to End of Fiscal Year.

Fiscal Year	End of Fiscal Year for the All-firm Sample													No. Securities
	Early Jan	End Jan	Mar 20	Mar 31	Apr 30	May 31	June 30	July 31	Aug 31	Sept 30	Oct 31	Nov 30	End Dec	
1968	0.9	4.5	0.45	5.9	2.7	0.45	3.6	1.4	4.5	1.4	6.3	1.8	66.1	221
1972	0.9	5.0	0.45	5.0	2.2	0.45	2.7	1.8	4.1	1.4	6.8	1.8	67.4	221
1976	0.9	6.3	0.45	6.3	1.4	0.45	1.4	1.4	3.6	2.2	5.4	1.4	68.8	221

the All-firm Sample, and comprised of those securities whose fiscal years ended at the end of December and in early January.

Care was taken to observe and record all changes in fiscal year-ends. There were twelve securities in the All-firm Sample[10] where fiscal year-end changes occurred in thirteen sample periods which affected the calculation of an annual E/P ratio. An example calculation of an E/P ratio for a security with a fiscal year-end change within a sample period is as follows:

> Dominion Bridge Company, Limited (security no. 88) had a twelve month EPS of $1.40 in 1968 whose fiscal year ended Oct. 31, and a fourteen month EPS of $1.69 in 1969 whose fiscal year ended Dec. 31. All data are as reported in the F.P. Cards and confirmed by annual reports. The concurrent pairs of "annual" EPS figures can be prorated to estimate an EPS for the 1968 sample calendar year by $1.40 (10/12) + $1.69 (2/14) = $1.41.

Stock Splits

It was necessary to make adjustments in the E/P ratio whenever a stock split occurred for a security whose fiscal year did not end on or near December 31st of the sample period calendar year, and the stock split occurred within the following fiscal year. The EPS figure for the second fiscal year which overlapped the sample period calendar year was converted to what it would have been had no stock split occurred, whenever the date of the stock split occurred within that part of the second fiscal year not within the

sample period calendar year. Whenever the stock split occurred within both the second fiscal year and the sample period calendar year, the earnings per share figure for the first fiscal year which overlapped the sample period calendar year was converted to what it would have been had the stock split occurred within that fiscal year. The purpose of these adjustments is to match the earnings per share with the price per share figure in terms of the same number of shares which exist in the latter at the end of the sample period calendar year. There were eleven securities in the All-firm Sample[11] where stock splits occurred in the same number of sample periods which affected the calculation of an annual E/P ratio. An example calculation of an E/P ratio for a security which experienced a stock split during the second fiscal year but not within the sample period calendar year is as follows:

> HCI Holdings Ltd. (security no. 129) had a twelve month EPS of $1.87 in 1976 whose fiscal year ended Sept. 30, and a twelve month EPS of $0.52 in 1977 whose fiscal year also ended Sept. 30. All data are as reported in the F.P. Cards. The company had a 3:1 stock split on 21 Sept. 1977; that is, during the second fiscal year but not within the 1976 sample period calendar year. First, it is necessary to convert the EPS figure for the second fiscal year to what it would have been had no stock split occurred by $0.52 x 3 = $1.56. Next, the concurrent pairs of annual EPS figures are prorated to estimate an EPS for the 1976 sample period calendar year by $1.87 (9/12) + $1.56 (3/12) = $1.79.

Stock split information was gleaned from a variety of sources including the Financial Post tape, the F.P. Cards, annual reports, and personal communication.

Negative E/P Ratios

Although Reinganum (1981) only included firms with positive E/P ratios in his E/P portfolios,[12] the writer decided to include all securities with negative E/P ratios. It was felt that some of the largest abnormal returns might come from the outliers; therefore, such interesting data should not be excluded from an already small data base. For the Calendar-year Sample, the 1968 sample period had 4.8% negative E/P ratios, the 1972 sample period, 4.6%, and the 1976 sample period, 5.2% negative E/P ratios.

Distribution

Table XII shows the distribution of E/P ratios within each sample period. In common with the distribution of the D/P ratios is the fact that the tightest range of E/P ratios lies within the "medium" category, whereas the "low" category has the widest range for the 1972 and 1976 sample periods due to the existence of outlier negative values described previously.

Table XII
Distribution of E/P Ratios

Sample Period	Low		Medium		High		No. Securities
	Min.	Max.	Min.	Max.	Min.	Max.	
1968	-0.17600	0.04358	0.04431	0.06864	0.06898	0.57302	147
1972	-0.68000	0.05423	0.05660	0.08604	0.08604	0.78484	152
1976	-1.10000	0.09707	0.09760	0.15188	0.15474	1.25275	153

Concerning differences between sample periods, it is interesting to note the existence of a monotonic increase in the E/P ratio over time. This is probably a reflection of the earnings retention phenomenon which Lev (1974) explains as the practice of most firms to periodically retain a portion of their earnings thus causing the equity per share to increase over time.[13] Or it could be due to earnings being overstated as a result of not being adjusted for inflation, since the standard accounting practice is for depreciation and cost of goods sold to be based on historical costs rather than current market value.

NOTES

1. Industrial Compustat (1980: Section 9, pages 32-33).
2. Ibid (1980: Section 6, page 8).
3. Security nos. 106 and 270 in the Financial Post (TSE) tape; from the All-firm Sample.
4. Security nos. 36, 233, and 239 in the Financial Post (TSE) tape; from the All-firm Sample.
5. Security no. 222 in the Financial Post (TSE) tape; from the All-firm Sample.
6. Security nos. 47, 170, and 266 in the Financial Post (TSE) tape; from the All-firm Sample.
7. Bell and Howell (1977: 2).
8. Security nos. 11, 91, and 195 in the Financial Post (TSE) tape; from the Calendar-year Sample.
9. Security nos. 166 (All-firm Sample) for the 1968 sample period, and security no. 11 (Calendar-year Sample) for the 1972 sample period in the Financial Post (TSE) tape.
10. Security nos. 36, 43, 47, 88, 164, 186, 193, 222, 239, 266, 267, and 270 in the Financial Post (TSE) tape.
11. Security nos. 29, 40, 85, 95, 129, 130, 171, 229, 243, 244, and 280 in the Financial Post (TSE) tape.
12. Reinganum (1981: 35).
13. Lev (1974: 18).

APPENDIX C

ADDITIONAL INFORMATION ON FIRM SIZE

Sources

Table XIII lists the sources used to calculate firm size for the Calendar-year Sample. A comparison with Table VI panel (a) shows that the sources used are very similar to the sources of EPS used to calculate E/P ratios. There is a small increase in the proportion of F.P. Cards used, and a corresponding reduction in the use of supplementary sources.

Distribution

Table XIV shows quite a different distributional pattern as compared with those of the other two firm-specific variables. The ranges increase exponentially from the "small" to the "large" categories for all three sample periods. The tightest range is in the low category, because Reinganum discovered that "... small firms systematically experienced average rates of return significantly greater than those of large firms with equivalent beta risk ..."[1] which confirmed Banz's findings that "... firms with very small market values (relative to the rest of the market) had

Table XIII
Sources of Firm Size Data

Sample Period	Sources of Firm Size Data (%)						No. Securities
	Compu-stat-Can	F.P. Cards	Personal Commun.	Annual Reports	CAN/ FIL	Stock Guides	
1968	64.9	29.1	2.0	3.4	-	0.6	147
1972	62.1	32.0	2.0	3.3	-	0.6	152
1976	63.0	33.1	1.3	2.0	0.6	-	153

Table XIV
Distribution of Firm Size (x 10^{-6})

Sample Period	Large		Medium		Small		No. Securities
	Max.	Min.	Max.	Min.	Max.	Min.	
1968	2,956.84	164.82	153.81	32.49	32.47	1.63	147
1972	6,362.67	163.75	160.94	33.82	33.75	1.40	152
1976	3,175.39	176.19	165.83	30.55	29.79	0.60	153

large and positive residual returns."[2] Similarly, the differences between sample periods are relatively minor, with the exception of an unusually large maximum value in the high category in the 1972 sample period, due to a proportionately larger number of large firm-size values in this sample period.

NOTES

1. Reinganum (1981: 45).
2. Ibid (1981:38).

APPENDIX D

ADDITIONAL INFORMATION ON BETA COEFFICIENTS

Results

Introduction

The computer output included some interesting "spinoff" information not relevant to the methodology of calculating abnormal returns, but, nevertheless, of academic interest to anyone who uses beta coefficients. Some of this information has been compiled in this appendix with a minimum of commentary from the writer. The results for the All-firm Sample have been used in this separate study, in order to gain the benefit of the largest sample size.

Relative Magnitude of β_{2i}

As mentioned in Chapter IV, beta was subdivided into two components, since it was postulated that some thinly traded securities known to exist on the TSE may be adjusting for market events during the previous week. How large were these β_{2i} values relative to the main β_{1i}? Table XV shows the distribution of β_{2i} values relative to β_{1i} values for

Table XV. Percent Distribution of $|\beta_{2i} \div \beta_{1i}| \times 100$.

$|\beta_{2i} \div \beta_{1i}|$ x 100 → / Beta Period ↓	< 10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-120	120-140	140-160	160-180	180-200	200-300	300-400	400-500	500-1000	> 1,000
1 (1965-1968)	14.5	19.4	20.8	12.7	5.9	4.1	4.5	1.3	2.3	0	2.7	0.9	1.3	0.5	0.9	3.2	1.8	0.5	0.9	1.8
		$\bar{x}$ = 35.7				s = 35.6				n = 203								n = 18 omitted from $\bar{x}$, s		
2 (1969-1972)	20.8	21.7	17.2	14.0	6.3	2.7	2.3	3.6	0.9	1.4	1.4	0	0.9	0.9	0	0.9	0.5	1.8	1.4	1.3
		$\bar{x}$ = 29.8				s = 29.5				n = 208								n = 13 omitted from $\bar{x}$, s		
3 (1973-1976)	20.8	23.1	22.6	9.5	4.5	3.1	2.3	2.3	0.9	2.3	1.4	3.1	0	0.5	0	0.9	0.9	0.9	0	0.9
		$\bar{x}$ = 30.4				s = 30.5				n = 213								n = 8 omitted from $\bar{x}$, s		

the three beta periods.[1] Surprising to the writer, the β_{2i} values were relatively large, and consistently so across the three beta periods. The only consistent trend was for the largest β_{2i} values (relative to β_{1i}) to exist in the earliest beta period, which may imply that the largest adjustments during the previous week occurred during this period. An explanation for the overall high β_{2i} values could be purely statistical; that is, this coefficient may be biased due to non-linearity in the model.

Significant and Insignificant Coefficients

As described in Chapter IV, β_{1i} and β_{2i} were summed in every case to yield β_i for each security, regardless of the level of significance of each coefficient. The levels of significance of the beta coefficients were disregarded since, in the process of forming the intermediate portfolios, the security betas were summed and averaged to yield a market portfolio with a beta of one, equivalent to that of the market. None of the previous researchers whose methodologies were most similar to that of the writer[2] took t values of the beta coefficients into account when forming their market portfolios. In fact, Watts (1978) determined empirically that the calculation of abnormal returns is not particularly sensitive to the weighting methodology of the intermediate portfolios.[3] Nevertheless, it is interesting

from an academic viewpoint to determine any differences in the proportions of significant and positive beta coefficients over time.

Table XVI shows a breakdown of the proportion of securities in the All-firm Sample which were significant or not for both β_{1i} and β_{2i}. The strongest trend exists in the upper-left cell (where the proportion of securities with both beta coefficients for any one security being both significant) increase over time. A similar trend is seen to exist in the marginal cells, where the proportion of securities with one of the beta coefficients being significant also increases over time. This could represent a statistical phenomenum, or could represent a general strengthening in beta values over time. In this connection, it may be pertinent to note that six of the seven short betas in Period 1[4] had insignificant β_{1i}'s and significant β_{2i}'s, which may explain the weak time series trend in this cell in Table XVI and explain one source of weakness in beta values. Although it was hypothesized previously that the largest adjustments during the previous week may have occurred during Beta Period 1, the increasing proportion of significant β_{2i}'s over time may indicate that the relative proportion of thinly traded securities increases over time.

Table XVII lists additional information on the two beta values, as well as β_i where β_{1i} and β_{2i} are both significant. Some of the trends here support the research

Table XVI. Percent Distribution of Significant and Insignificant β_{1i} and β_{2i} Coefficients.

β_{2i} ↓ / β_{1i} →		Significant @5%			Insignificant			Σ		
		Period 1	Period 2	Period 3	Period 1	Period 2	Period 3	Period 1	Period 2	Period 3
Significant @5%	Period 1	13.6			6.3			19.9		
	Period 2		16.8			5.9			22.6	
	Period 3			24.9			2.3			27.1
Insignificant	Period 1	63.3			16.8			80.1		
	Period 2		68.7			8.6			77.4	
	Period 3			61.5			11.3			72.9
Σ	Period 1	76.9			23.1			100		
	Period 2		85.5			14.5			100	
	Period 3			86.4			13.6			100

Table XVII. Miscellaneous Information on Beta Coefficients.

Beta Period ↓	β_{1i} Significant		β_{1i} Insig.	β_{2i} Significant		β_{2i} Insig.	β_i Both Significant	
	$\bar{x}$	% Pos.	% Pos.	$\bar{x}$	% Pos.	% Pos.	$\bar{x}$	% Pos.
	s	n	n	s	n	n	s	n
1	1.2754	99.4	74.5	-0.0344	43.2	46.9	1.1521	100
(1965-1968)	0.4842	170	51	0.6757	44	177	0.3089	30
2	1.1881	100	84.4	-0.1066	40.0	43.3	0.9870	100
(1969-1972)	0.4962	189	32	0.5876	50	171	0.3892	37
3	1.1820	100	86.7	-0.1013	40.0	54.0	1.1677	100
(1973-1976)	0.5375	191	30	0.5004	60	161	0.3576	55

results compiled by Tiniç and West (1979).[5] For example, there is a tendency for the mean significant β_{1i}'s to regress towards the beta of the market over time. Also, the betas of larger portfolios are more stationary over time than for smaller portfolios, as evidenced by the differences between the means of the significant β_{1i} and β_i "portfolios" over time. Perhaps a new trend has been discovered, however, which is for the significant β_{2i} values to be consistently negative over all three beta periods.

Other Methodologies

Other models were considered for estimating the beta coefficients. Since weekly returns for Canadian securities are not perfectly normally distributed but instead tend to follow a leptokurtic distribution,[6] it was considered to transform the returns into the continuously compounded form. This procedure, however, was not adopted for the following reasons:

1. For small return values, such as exist over a holding period of one week, a log transformation would not have an appreciable effect on the weekly returns.
2. Although a log transformation will reduce positive skewness, it will not reduce leptokurtosis.
3. A log transformation will have a trivial effect on the beta value, since regression analysis is robust with

respect to estimating coefficients provided the returns are reasonably normally distributed. Non-normality affects the standard error and hence the t value, rather than the coefficient. In estimating betas, the t values were not considered.

4. There are problems interpreting the results when returns have been converted to log form. For example, the equation:

$$\ell n\ \tilde{R}_{it} = \alpha_{it} + \beta_{1i}\ \ell n\ \tilde{R}_{mt} + \beta_{2i}\ \ell n\ \tilde{R}_{mt-1} + \tilde{e}_{it}$$

is no longer a linear market model, but rather of the form:

$$\tilde{R}_{it} = (\ell n^{-1}\ \alpha_i)\ (\tilde{R}_{mt}{}^{\beta_{1i}})(R_{mt-1}{}^{\beta_{2i}})(\ell n^{-1}\ \tilde{e}_{it})$$

Another approach is to consider the possibility that, due to the lack of normality existing in the weekly returns on the individual securities and on the market, there may exist a bias in estimating $\beta_{1i} + \beta_{2i}$ due to non-linearity in the original model. The inclusion of a quadratic term for the return on the market as an additional independent variable in the adopted equation may yield a better fit. This, in turn, may reduce some of the bias in estimating beta. Again, this model was not adopted since the inclusion of a quadratic term would mean that we would be testing a

non-linear rather than a linear version of the Market Model. As has been mentioned previously, a general approach throughout this research has been to retain an element of simplicity, while at the same time conform as closely as possible to current practices in the literature.

NOTES

1. Refer to Figure 1 for a reminder of the definition of the "beta period".
2. i.e., Watts (1978), Morgan (1979), and Reinganum (1981).
3. Refer to endnote 34, Chapter IV.
4. Refer to endnote 26, Chapter IV.
5. Tiniç and West (1979: 477).
6. Verbal communication from Dr. B. Korkie in Finance 526 class, University of Alberta, January, 1981.

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